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MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

Volume XXXIII October-December 1988

CONTENTS

Studies on ectomycorrhizae XVI. Ectomycorrhizae formed by *Tricholoma flavobrunneum* and *Betula pendula* and *Tricholoma auratum* and *Pinus silvestris* . . . . **M. Uhl** 1

Dictyochaeta heteroderae, comb. nov. . . . **L. M. Carris and D. A. Glawe** 23

Lichens and air quality in Indiana Dunes National Lakeshore. **Clifford M. Wetmore** 25

Calocybe fallax: its ecology and cultural behavior. **Ivano L. Brunner and Orson K. Miller, Jr.** 41

Parvacoccum pini gen. et sp. nov. (Rhytismataceae) on western white pine. **R. S. Hunt and A. Funk** 51

Étude microscopique de specimens types de Russules tropicales de la sous-section *Diversicolores* . . . . **Bart Buyck** 57

Étude microscopique de specimens types de Russules tropicales de la sous-section *Pluviales* . . . . **Bart Buyck** 71

Studies in the genus *Phoma*. XIV. Concerning *Phoma herbarum*, the type species, a widespread saprophyte . . . . **Gareth Morgan-Jones** 81

Macrochemical color reactions of macromycetes. VI. Cluster analysis of color data . . . . **Harald M. Frank and Heinz Zwanaiger** 91

A note on Grelet's "Les Discomycètes de France" . . . . . . **Donald H. Pfister** 97

Vernally fruiting taxa of *Ramaria* from the Pacific Northwest. **Ronald H. Petersen and Catherine Scates** 101

A new species of the genus *Dictyophora* from China. **Mu Zang, De-rong Zheng, and Zhing-xian Hu** 145

The *Scutellinia* battle; the lost, missing and dead . . . . . . **Trond Schumacher** 149

Two new species of Agaricales from Brazil. **Marina Capelari and Rosana Maziero** 191

Galactomyces citri-aurantii a newly found teleomorph of *Geotrichum citrii-aurantii* the cause of sour rot of citrus fruit. **E. Butler, D. Fogle, and M. Miranda** 197

New species of *Inocybe* from southern California . . . **Florence H. Nishida** 213

Laccaria gomezii, a new agaric species from the Querceta of Colombia and Costa Rica . . . . **Gregory M. Mueller and Rolf Singer** 223

The genus *Helvella* in Alberta . . . . . . **Sean P. Abbott and R. S. Currah** 229

Acaulospora splendida, a new species in the Endogonaceae from Costa Rica. **Ewald Sieverding, Adelaida Chaverri, and Isabel Rojas** 251

[CONTENTS continued overleaf]

ISSN 0093-4666 MYXNAE 33 1-524 (1988)

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SEE ERRATA

[CONTENTS continued from front cover]

Notes on select corticiaceous fungi from Spain and North Africa. **Kurt Hjortstam, José L. Manjón, and Gabriel Moreno** 257
Annotated check-list with host data and decay characteristics for Colorado wood rotting Basidiomycotina .... **J. Page Lindsey** 265
New *Xanthoparmelia* (lichenized Ascomycotina) from Brazil. **Anthony Fletcher and Mason E. Hale** 279
Are there *Thecaphora* species (Ustilaginales) on Gramineae? **Kálmán Vánky and Mary Berbee** 281
A new species of *Arthroderma* from Japanese soil. **Shun-ichi Udagawa, Hitoshi Kubo, and Hideomi Shibaki** 283
Emericellopsis sphaerospora and *Kernia peruviana,* two new soil-borne cleistothecial Ascomycetes . . **Shun-ichi Udagawa and Kouhei Furuya** 291
Type studies in the Polyporaceae — 20. Species described by G. Bresadola. **Leif Ryvarden** 303
Additions to *Condylospora* (Hyphomycetes) from Malaysia. **A. Nawawi and A. J. Kuthubutheen** 329
Studies in the genus *Phoma.* XV. Concerning *Phoma multirostrata,* a leaf spot-inducing and soil-borne species in warm climates. **Gareth Morgan-Jones** 339
Further new species of *Relicina* and *Xanthoparmelia* (lichenized Ascomycotina) from the southern hemisphere . . . **John A. Elix and Jen Johnston** 353
Taxonomical studies on Ustilaginales. III .... **Kálmán Vánky** 365
Some new or unusual corticioid fungi from the Gulf Coast region. **R. L. Gilbertson and Meredith Blackwell** 375
Terminology of spore states in Uredinales .... **D. B. O. Savile** 387
New species and new reports of *Flavoparmelia* (lichenized Ascomycotina) from the southern hemisphere ...... **John A. Elix and Jen Johnston** 391
New combinations in the lichen genus *Xanthoparmelia* (Ascomycotina: Parmeliaceae) .... **Mason E. Hale** 401
Notes on hyphomycetes. LIX. *Curvularia bannonii* sp. nov., an undecribed leaf pathogen of *Jacquemontia tamnifolia* ...... **Gareth Morgan-Jones** 407
Hypoxylon oceanicum sp. nov. from mangroves .... **Scott Schatz** 413
A new species of *Cyathus* from Mexico. **Calixto León-Gómez and Evangelina Pérez-Silva** 419
A new species of *Meloderma* (Rhytismataceae) with notes on *Meloderma* and related genera .... **Peter R. Johnston** 423
Dermocybe (Cortinariaceae, Agaricales): North American names — new combinations, synonyms and notes .... **Joseph F. Ammirati** 437
Resurrection of the lichen genus *Pleurosticta* Petrak (Parmeliaceae: Ascomycotina) .... **H. Thorsten Lumbsch, Hans W. Kothe, and John A. Elix** 447
Chemical variation in the lichen genus *Diploicia* (Ascomycotina). **John A. Elix, Gillian J. Jenkins, and H. Thorsten Lumbsch** 457
Ascomycotina from Antarctica. **Irma J. Gamundí and Horacio A. Spinedi** 467
Notes on hyphomycetes. LX. *Corynespora matuszakii,* an undescribed species with narrow, cylindrical, catenate conidia and highly-reduced conidial lumina .... **Gareth Morgan-Jones** 483
Book Reviews .... **G. L. Hennebert** 489
NOTICE: IMC4 Regensburg (1990), First Circular 497

Author INDEX 498
Reviewers 500
INDEX to Fungous and Lichen Taxa 501
Errata 524
Publication date, MYCOTAXON Volume 31(2) 524

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ERRATA, VOLUME THIRTY-THREE

Cover 2		line 44	for	Gillian J.	read	Gillian A.
Page	498	22,48	for	Gillian J.	read	Gillian A.

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			7	*for*	WILCOXINA SEQUOIA	*read*	WILCOXINA SEQUOIAE
			10	for	*P. sequoia*	read	*P. sequoiae*
	523		44	for	sequoia	read	sequoiae

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TABLE OF CONTENTS, VOLUME THIRTY-THREE

October—December, 1988

Studies on ectomycorrhizae XVI. Ectomycorrhizae formed by *Tricholoma flavobrunneum* and *Betula pendula* and *Tricholoma auratum* and *Pinus silvestris* .... **M. Uhl** 1

Dictyochaeta heteroderae, comb. nov. ... **L. M. Carris and D. A. Glawe** 23

Lichens and air quality in Indiana Dunes National Lakeshore. **Clifford M. Wetmore** 25

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Studies in the genus *Phoma.* XIV. Concerning *Phoma herbarum,* the type species, a widespread saprophyte .... **Gareth Morgan-Jones** 81

Macrochemical color reactions of macromycetes. VI. Cluster analysis of color data ....**Harald M. Frank and Heinz Zwanaiger** 91

A note on Grelet's "Les Discomycètes de France" ...... **Donald H. Pfister** 97

Vernally fruiting taxa of *Ramaria* from the Pacific Northwest. **Ronald H. Petersen and Catherine Scates** 101

A new species of the genus *Dictyophora* from China. **Mu Zang, De-rong Zheng, and Zhing-xian Hu** 145

The *Scutellinia* battle; the lost, missing and dead ...... **Trond Schumacher** 149

Two new species of Agaricales from Brazil. **Marina Capelari and Rosana Maziero** 191

Galactomyces citri-aurantii a newly found teleomorph of *Geotrichum citrii-aurantii* the cause of sour rot of citrus fruit. **E. Butler, D. Fogle, and M. Miranda** 197

New species of *Inocybe* from southern California ... **Florence H. Nishida** 213

Laccaria gomezii, a new agaric species from the Querceta of Colombia and Costa Rica .... **Gregory M. Mueller and Rolf Singer** 223

The genus *Helvella* in Alberta ...... **Sean P. Abbott and R. S. Currah** 229

Acaulospora splendida, a new species in the Endogonaceae from Costa Rica. **Ewald Sieverding, Adelaida Chaverri, and Isabel Rojas** 251

Notes on select corticioid fungi from Spain and North Africa. **Kurt Hjortstam, José L. Manjón, and Gabriel Moreno** 257

Annotated check-list with host data and decay characteristics for Colorado wood rotting Basidiomycotina .... **J. Page Lindsey** 265

New *Xanthoparmelia* (lichenized Ascomycotina) from Brazil. **Anthony Fletcher and Mason E. Hale** 279

Are there *Thecaphora* species (Ustilaginales) on Gramineae? **Kálmán Vánky and Mary Berbee** 281

A new species of *Arthroderma* from Japanese soil. **Shun-ichi Udagawa, Hitoshi Kubo, and Hideomi Shibaki** 283

Emericellopsis sphaerospora and *Kernia peruviana,* two new soil-borne cleistothecial Ascomycetes . . **Shun-ichi Udagawa and Kouhei Furuya** 291

Type studies in the Polyporaceae — 20. Species described by G. Bresadola. **Leif Ryvarden** 303

Additions to *Condylospora* (Hyphomycetes) from Malaysia. **A. Nawawi and A. J. Kuthubutheen** 329

Studies in the genus *Phoma*. XV. Concerning *Phoma multirostrata*, a leaf spot-inducing and soil-borne species in warm climates. **Gareth Morgan-Jones** 339
Further new species of *Relicina* and *Xanthoparmelia* (lichenized Ascomycotina) from the southern hemisphere . . . **John A. Elix and Jen Johnston** 353
Taxonomical studies on Ustilaginales. III . . . . **Kálmán Vánky** 365
Some new or unusual corticioid fungi from the Gulf Coast region. **R. L. Gilbertson and Meredith Blackwell** 375
Terminology of spore states in Uredinales . . . . **D. B. O. Savile** 387
New species and new reports of *Flavoparmelia* (lichenized Ascomycotina) from the southern hemisphere . . . . . . **John A. Elix and Jen Johnston** 391
New combinations in the lichen genus *Xanthoparmelia* (Ascomycotina: Parmeliaceae) . . . . **Mason E. Hale** 401
Notes on hyphomycetes. LIX. *Curvularia bannonii* sp. nov., an undecribed leaf pathogen of *Jacquemontia tamnifolia* . . . . . . **Gareth Morgan-Jones** 407
Hypoxylon oceanicum sp. nov. from mangroves . . . . **Scott Schatz** 413
A new species of *Cyathus* from Mexico. **Calixto León-Gómez and Evangelina Pérez-Silva** 419
A new species of *Meloderma* (Rhytismataceae) with notes on *Meloderma* and related genera . . . . **Peter R. Johnston** 423
Dermocybe (Cortinariaceae, Agaricales): North American names — new combinations, synonyms and notes . . . . **Joseph F. Ammirati** 437
Resurrection of the lichen genus *Pleurosticta* Petrak (Parmeliaceae: Ascomycotina) . . . . **H. Thorsten Lumbsch, Hans W. Kothe, and John A. Elix** 447
Chemical variation in the lichen genus *Diploicia* (Ascomycotina). **John A. Elix, Gillian J. Jenkins, and H. Thorsten Lumbsch** 457
Ascomycotina from Antarctica. **Irma J. Gamundí and Horacio A. Spinedi** 467
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Book Reviews . . . . **G. L. Hennebert** 489

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NOTICE: IMC4 Regensburg (1990), First Circular 497

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Reviewers 500
INDEX to Fungous and Lichen Taxa 501
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Publication date, MYCOTAXON Volume 31(2) 524

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STUDIES ON ECTOMYCORRHIZAE XVI *)

ECTOMYCORRHIZAE FORMED BY TRICHOLOMA FLAVOBRUNNEUM AND BETULA PENDULA AND TRICHOLOMA AURATUM AND PINUS SILVESTRIS

by

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Keywords: ectomycorrhizae, Tricholoma flavobrunneum, Tricholoma auratum, Betula pendula, Pinus silvestris. **Summary:** The mycorrhizae formed by Tricholoma flavobrunneum and Betula pendula and Tricholoma auratum and Pinus silvestris are described and compared. They differ in the morphological characteristics of the rhizomorphs and emanating hyphae as well as in fluorescence and reactivity to brillant-cresyl-blue. Both ectomycorrhizae are white and densely stringy. The anatomical and morphological features of Tricholoma mycorrhizae characterized so far in this series are discussed and a key is given for them.

I. Material and Methods

The methods used here for isolating and documenting ectomycorrhizae from soil are given in Agerer (1986, 1987). The methods for studying the morphology and anatomy of ectomycorrhizae as well as an evaluation of the characteristics used to identify them are given in Agerer (1986, 1987c).

*) Studies on Ectomycorrhizae XV (Uhl 1987)

II.Description of the Ectomycorrhizae

1. Tricholoma flavobrunneum (Fr.)Kummer (Figs.1-4)
Host: Betula pendula

A.Morphological characteristics (Fig.1a)

Mycorrhizal system up to 6 mm long, irregularly ramified; unramified ends up to 4 mm long and 0.3mm in diameter; ends bent or tortuous; surface densely stringy; color dirty whitish, sometimes brownish; with a silvery-shining appearance caused by enclosed air after replacing air with water, yellowisch-brown.

Outer surface of mantle (Figs.1b;4a). Plectenchymatous; no distinct patterns recognizable; hyphae 3-5µm in diameter; cell walls inconspicuous; yellowish from membranaceous and plasmatic pigment. Cystidia not found.

Middle layer of mantle (Figs.1e;4b). More densely plectenchymatous than outer parts of mantle, sometimes epidermoid cells visible;hyphae up to 5µm in diameter.

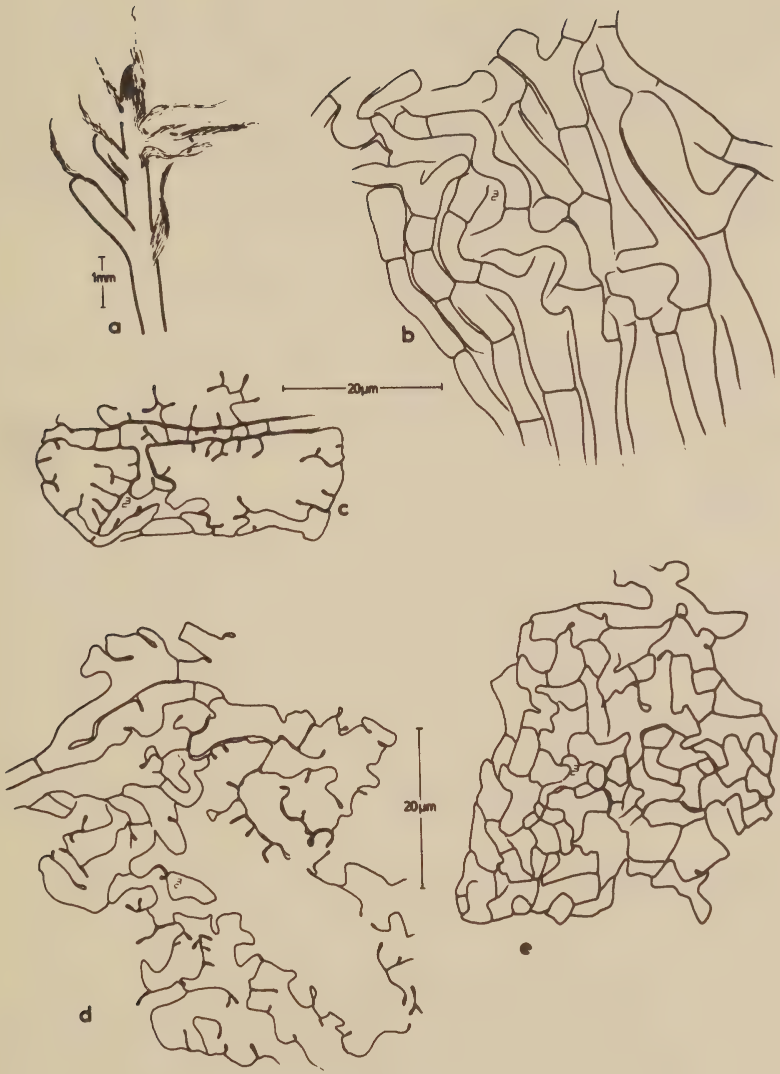
Inner surface of mantle (Fig.1d) Pseudoparenchymatous; sometimes palmetti forming as in the Hartig net; cell-walls inconspicuous.

Emanating hyphae (Figs.3a-d). Hyphae 4-6(7)µm in diameter; multiply ramified; septa up to 150µm apart; with contact septa present; clamp connections absent; anastomoses frequent (Figs.3b,3d); very apex of hyphae thickened; hyphae with yellow incrustations, visible only in fresh material, dissolving in acidic solutions.

Rhizomorphs (Figs.2a,2b;4d,4e). Rhizomorphs up to 0.4mm thick; growing off in a flat angle from the mycorrhizae; with few hyphae emanating from rhizo-

---

Fig. 1 Tricholoma flavobrunneum
a) Habit; b) Mantle, surface-view; c) Plan-view of Hartig net, palmetti-type; d) Mantle, innermost layer; e) Optical section of mantle, 10µm deeper than b). (all figs. from Herb. UM-X20)


1mm
a
b
20µm
c
20µm
d
e

morphs; hyphae parallel to the rhizomorphal axis; rhizomorph differentiated: central hyphae: hyphae 8-10µm in diameter; often inflated; septa 50-60µm apart; cell walls inconspicuous; surface of hyphae smooth, with yellowish membranaceous and plasmatic pigment; cell lumen with octahedral crystals. outer hyphae,(around central hyphae): hyphae 4-6µm in diameter; septae 25-40(60)µm apart; cell walls inconspicuous; hyphae with yellowish incrustations, visible only in fresh material, and yellowish from membranaceous and plasmatic pigment; some clamp connections; contactsepta frequent.

C. Anatomical characteristics, crosssection (Fig.4f)

Mantle plectenchymatous, 5-15µm thick, no distinct layers recognizable: hyphae, especially in outer regions, losely interwoven, in the inner parts more or less compactly arranged; hyphae tangentially (2)3-5(7)µm, radially 2-3(4)µm. Tannin cells: tangentially elongated, irregularly compressed, one row recognizable; tangentially 10-30µm, radially 4-10µm; TCt=18.3µm; TCq=2.5. Cortical cells: in 4-5 rows; outer row radially rectangular, tangentially 13-20µm, radially (30)40-50(55)µm; CCt=15.0µm; inner rows roundish 20-30 x 30µm; CCt=15.0µm; CCq=0.33. Hartig net (Fig.4f): number of hyphal rows around tannin cells and around cortical cells 1; Hyphae round to oval, 3-5µm in diameter.

D. Anatomical characteristics, longitudinal section (Fig. 2a;3a;4c)

Mantle hyphae radially 3-5µm, tangentially 4-10µm.; Tannin cells irregularly compressed, es-

---

Fig. 2 Tricholoma flavobrunneum
a)Longitudinal section of mycorrhizal tip with rhizomorphs, growing off at a flat angle; in upper part with incrustations, visible only in fresh material (cc= cortical cell; tc=tannincell); b)Rhizomorph with centrally arranged, inflated hyphae on enlarged diameter (all figs. from Herb. UM-X20).

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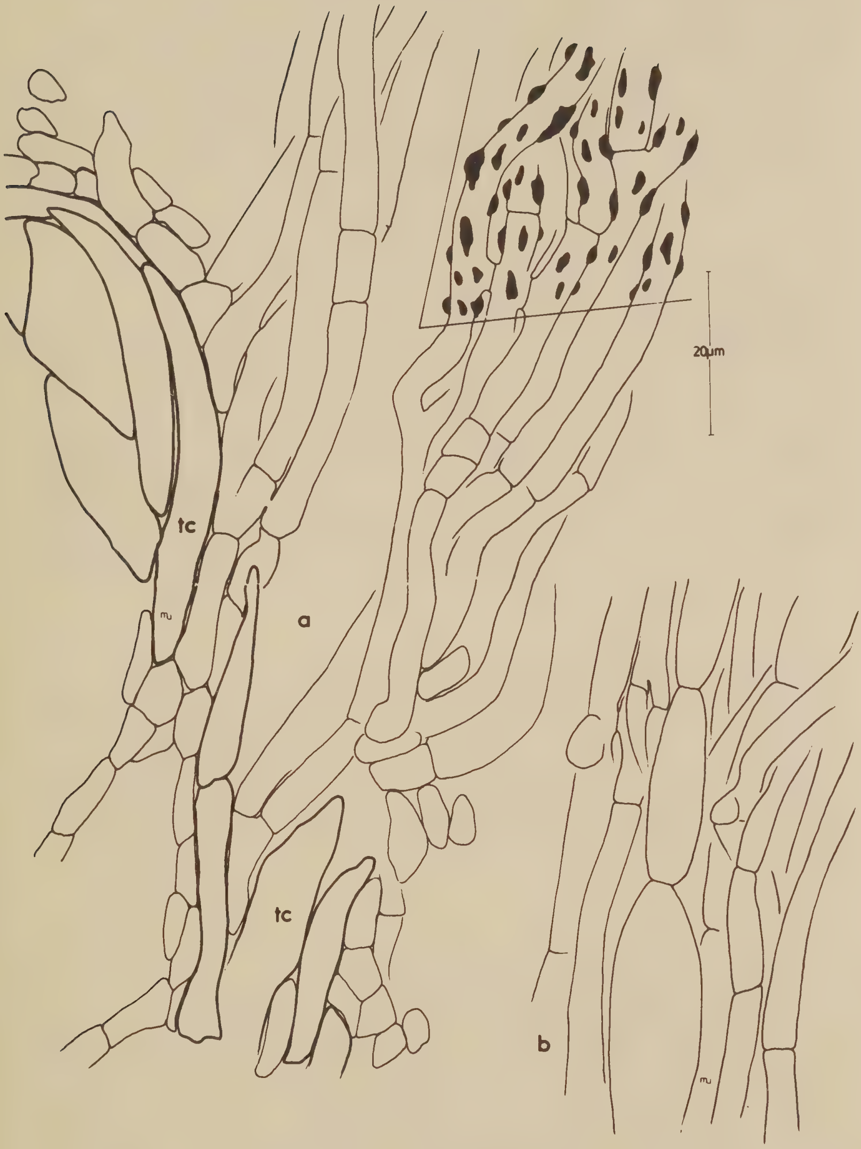

tc
a
20µm
tc
b

pecially distally, partly overlapping each other, tangentially (10)20-30µm, radially 4-10µm;TCt=24.7µm; TCq=3.4; Cortical cells: outer row: radially rectangular, obliquely oriented , parallel, palisadelike, tangentially (8)10-15µm, radially (30)40-50(55); CCt=12µm; CCq=0.26; inner rows: roundish, (20-30 x 30µm); Hartig'net of palmetti type, lobes very faint, 2(4)µm broad (Fig. 3a,1c).

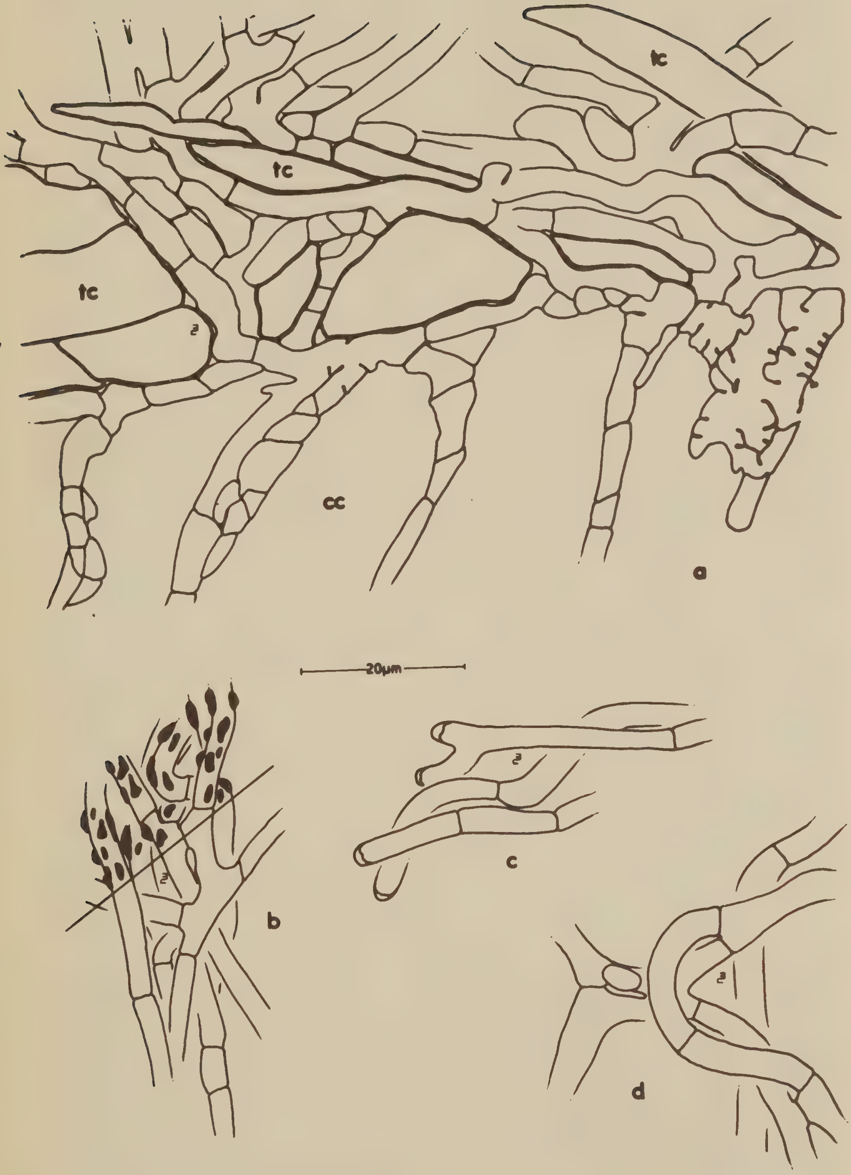
E. Colour-reactions in different reagents

Aceto-carmine: incrustations dark yellow; Acetic-Fuchsin: --; Anilin: --; Brillant-Cresyl-Blue: blue, after washing with water: emanating hyphae violet, hyphae of mantle greenish, incrustations reddish violet; Cottonblue: --; Ethanol 70%: --; Guaiac: -;Iron-sulfate: brownish; KOH: brown, incrustations not dissolved; Melzer's reagent: --; Phenol: --; Phenol-Anilin: --; Sulfo-Vanillin: tannin cells and palisade-like cortical cells yellowish-red, hyphae hyaline, incrustations dissolved.

F. Autofluorescence

Whole mycorrhizae: UV 254 nm: --; UV 366 nm: --; Mantle: (observed in lactic acid) UV-filter (340-380nm): slightly blue; Blue-filter (450-490nm): greenish yellow; Green-filter (530-560nm): --. Tannin cells: UV-filter: --; Blue-filter: reddish; Green-filter:--; palisade like outer cortical cells: UV-filter: --; Blue-filter: reddish-yellow; Greenfilter: --.

Fig. 3 Tricholoma flavobrunneum
a) Longitudinal section, proximal from 2a, with Hartig net, emanating hyphae and tannin cells (cc= cortical cell; tc= tannin cell); b-d) Emanating hyphae: b) with contact-septa; in upper part with incrustations, visible only in fresh material; c) Thickened cell-walls of hyphal ends, like caps; d) Contact septa of emanating hyphae (all figs. from Herb. UM-X20).


tc
tc
tc
tc
cc
a
20µm
b
c
d

G. Staining of nuclei

Two nuclei per cell; distance of nuclei varying from close up to 25µm apart; round to oval; 1.5-2µm in diameter; no siderophilous granulation (method: aceto-carmine).

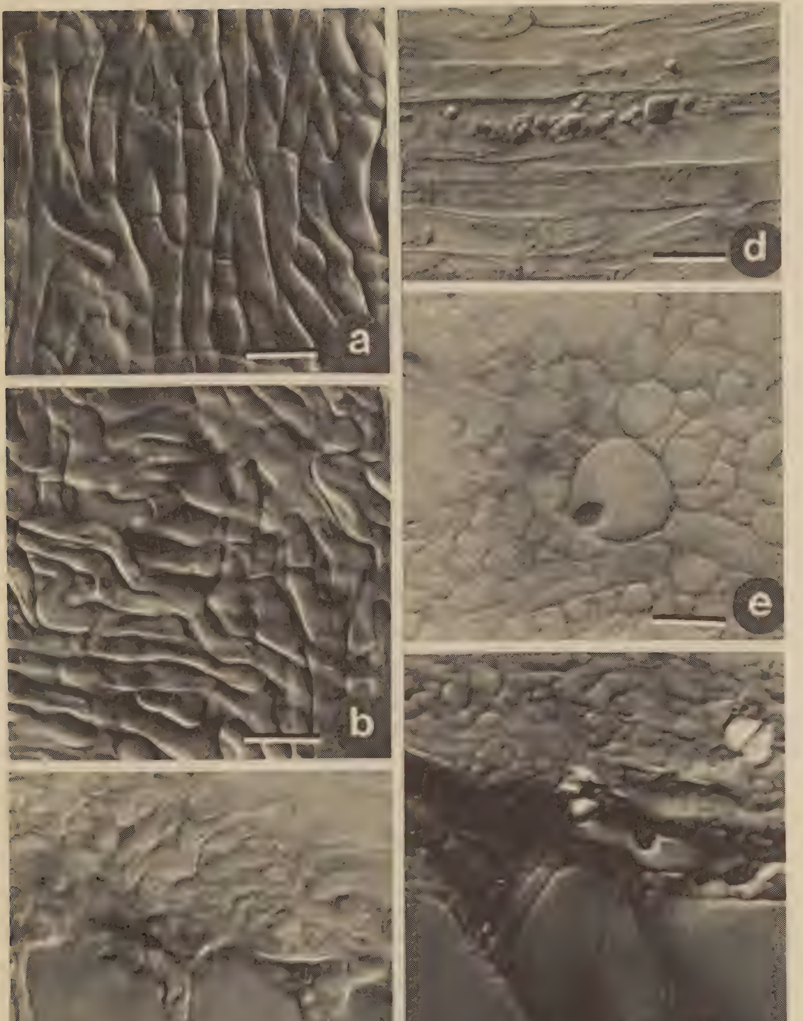
Ectomycorrhizae of Tricholoma flavobrunneum reported in the literature

Melin (1923) synthesized ectomycorrhizae with T. flavobrunneum and Betula pendula. They were characterized as being monopodially branched, with unramified ends, white, up to 0.4 mm in diameter with the rhizomorphs up to 50µm in diameter. The mantle was up to 40µm thick, pseudoparenchymatous with numerous hyphae and hyphal strands radiating into the medium. The Hartig net was developed only in the outer parts of the palisade-like cortical cells. Additionally, intracellular penetrations, especially in the palisade-like cortical cells and the adjoining row of cortical cells, were reported. These infections could not be seen in the present material whereas other characteristics were more or less corroborated.

Norkrans (1949) described the synthesized ectomycorrhizae of Tricholoma flavobrunneum with Pinus silvestris as having no sheath but a well developed Hartig net. This deviation may be due to the

---

Fig. 4 Tricholoma flavobrunneum
a) Mantle, surface-view; b) Mantle, plan-view, 10µm deeper than 4a; c)Longitudinal section of mycorrhiza with mantle, palisadelike cortical cells and paraepidermal Hartig net, reaching only the second row of cortical cells; d)Longitudinal section of rhizomorph, showing larger central hyphae, filled with crystals; e) Cross section of rhizomorph, central hyphae with crystal; f)Cross section of mycorrhiza with mantle, cortical cells and Hartig net (seems not to be paraepidermal, but the cortical cells are lying obliquely inward backwards) (all figs from Herb. UM-X20; bar represents 10µm).


a
b
c
d
e
f

different host or factors of synthesis of the mycorrhizae.

Godbout & Fortin (1984) compared the characteristics of synthesized mycorrhizae (growthpouch-method) of some agaric genera. They stated that the white, cottony, two-layered mantle was a common characteristics of Tricholoma ectomycorrhizae. Unfortunately no further features were compared by the authors.

Material studied and method of identification

Reference specimen: Germany, Bavaria, Weilheim, Peissenberg, Schweinefilz (Betula pendula), 11.10.1986. Fruitbody Herb. UM-203 and mycorrhizae Herb. UM-X20, in M; There were direct connections between fruitbody and mycorrhizae via rhizomorphs.

2. **Tricholoma auratum** (Paul.ex Fr.)Gillet

(Fig 5a-e;6a and 6b)
Host: Pinus silvestris

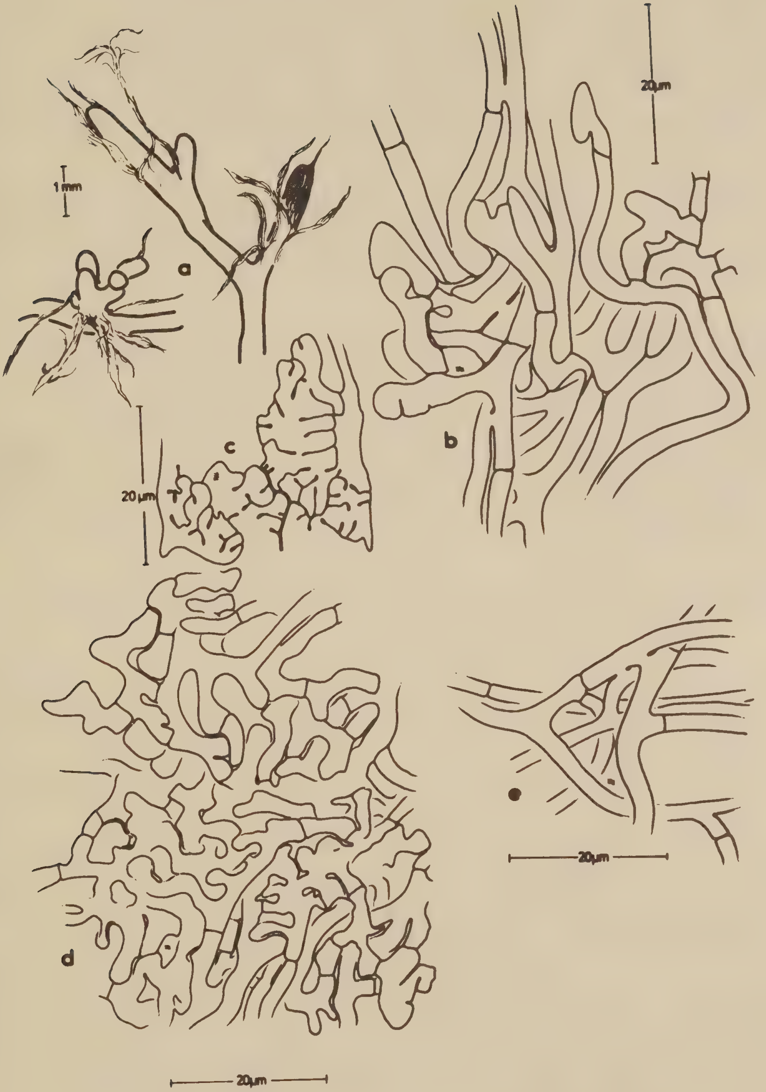
A. Morphological characteristics (Fig.5a)

Mycorrhizal system up to 3mm long; Mycorrhizae bifurcated, sometimes irregularly branched; unramified ends up to 2mm long and up to 0.4µm in diameter, mostly straight, irregularly branched parts bent to tortuous ; surface densely stringy; yellowish white; silvery-shining caused from enclosed air, after displacing of air by water more or less yellowish brown.

B. Anatomical characteristics of surface

Outer surface of mantle (Figs.5b;7a-7c;8c) Plectenchymatous, hyphae loosely interwoven, hyphae 3µm in diameter, gradually developing into somewhat

Fig. 5 Tricholoma auratum
a) Habit; b) Surface view of mantle; c) Surface view of Hartig net, tangential section; d) Inner surface of mantle; e) Emanating hyphae with anastomoses (all figs. from UM-D80).


1 mm
a
20µm
b
c
20 µm
T
d
20µm
20µm

thicker (up to 4µm) emanating hyphae; cell walls inconspicuous, yellowish from membranaceous pigment; surface of the very tip plectenchymatous; cystidia not found. Inner surface of mantle (Fig. 8d) Pseudoparenchymatous with hyphal and epidermoid cells; rather densely arranged, no recognizeable regular patterns ; up to 20 cells per 400µm² area; cell-walls inconspicuous.

Emanating hyphae (Figs.5e;8b) 2-4µm in diameter; cell walls inconspicuous, smooth, without incrustations; hyphae yellowish from membranaceous pigment; septa without clamp connections.

Rhizomorphs (Figs. 6a,6b;7d-7f) Up to 0.3mm thick; growing from mycorrhizae at a flat angle, running along mycorrhizal surface; few hyphae emanating from rhizomorphs; hyphae densely interwoven; rhizomorphs differentiated into narrow (2-4µm) and broad (8(10)µm) hyphae, but broad hyphae not centrally arranged; cell-walls inconspicous; hyphae yellowish from membranaceous and plasmatic pigment.

C. Anatomical characteristics, cross-section (Figs.8d)

Mantle: Plectenchymatous throughout, 20-30(35)µm thick; distinct layers lacking, more or less compacted only in the inner part of the mantle; hyphae tangentially 3-4µm, radially 2-3µm and longer (the first cut emanating hyphae). Tannin cells: tangentially irregularly elliptical or oval, compressed, one row recognizable; tangentially 30-60(80)µm, radially (4)8-15µm, TCt=44.8µm, TCq=5.6. Cortical cells: 4-5 rows ; round to radially oval, tangentially (15)25-60µm, radially 25-60µm, CCt=32.8µm, CCq=0.85; Hartig net: found in 3-5 rows of cortical cells; Hartig net around tannin thick; number of hyphal rows 1; Hartig net cells cells 3-5µm in section irregularly short-oval or round; Hartig net around cortical cells 3-8µm thick, number of hyphal rows 1-2; Hartig net cells in section irregularly short-oval or round.

D. Anatomical characteristics, longitudinal section (Fig.8e)

Mantle at very tip 20-25µm thick; through older parts of the mantle thicker up to 35µm, plectenchymatous throughout; distinct layers lacking; outermost hyphae tangentially 3-4µm, radially 2-3µm, next to cortical cells tangentially 5-20µm, radially 2-3µm. Tannin cells irregularly elongated oval or round; tangentially 30-50(60)µm, radially (4)8-15µm, TCt=41µm, TCq=5,1. Cortical cells more or less round to isodiametric, tangentially (15)30-45(60)µm, radially 25-60µm, CCt=33,5µm, CCq=0,86. Hartig net in surface view: palmetti with lobes 2-3(4)µm broad (Fig. 5c).

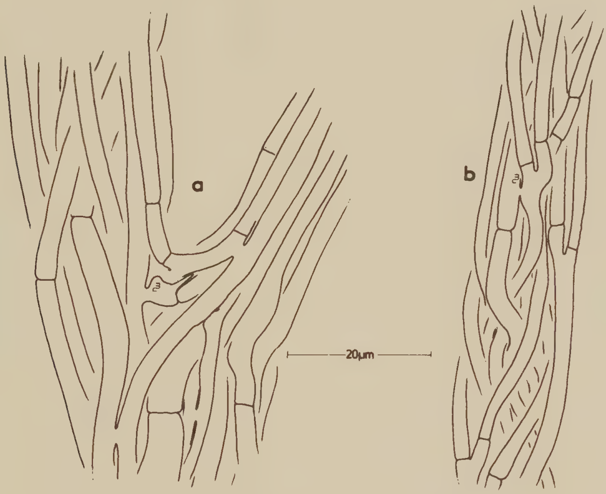


Fig. 6 Tricholoma auratum
a) Branching rhizomorph in longitudinal section; b) Single rhizomorph, anastomoses (all figs. from Herb. UM-D80).

E. Colour reactions in different reagents

Acetic-Fuchsin: --; Anilin: --; Brillant-Cresyl-Blue: blue; after washing with water: rims of mantle piece slightly violet; Cotton-Blue: --; Ethanol 70%: --; Guaiac: --; Iron-Sulfate: brownish; KOH 15%: --; Melzer's Reagent: --; Phenol: --; Phenol-Anilin: --; Sulvo-Vanillin: hyphae hardly recognizable.

F. Autofluorescence

Whole mycorrhizae UV 254nm:--; UV 366nm:--. Mantle and Hartig net: UV-filter(340-380nm): --; Blue-filter(450-490nm): --; Green-filter:(530-560nm): --; Tannin cells: UV-filter: --; Bluefilter: reddish yellow; Green-filter: --; emanating hyphae: UV-filter: --: Blue-filter: slightly yellow; Green-filter: --;

G. Staining of nuclei

Hyphae usually with one pair of nuclei, distance between the nuclei varies, mostly 5 to 10μm apart; nuclei round to oval , with diameter of 0.8-2μm; no siderophilous granulation (method: aceto-carmine).

Material studied and method of identification

Reference specimen: Germany, Bavaria, Kelheim, Siegenburg, on *Pinus silvestris*, leg. M. Uhl, 23.9.1986, fruitbodies Herb. UM-188 and mycorrhizae Herb. UM-D80, in M.. Some rhizomorphic connections could be seen between fruitbodies and mycorrhizae. Further specimen studied: Herb. UM-D120, 23.9.1986, location as for Herb. UM-D80.

Mycorrhizae of Tricholoma auratum reported in the literature

No anatomical or morphological studies of the ectomycorrhizae of *Tricholoma auratum* have been

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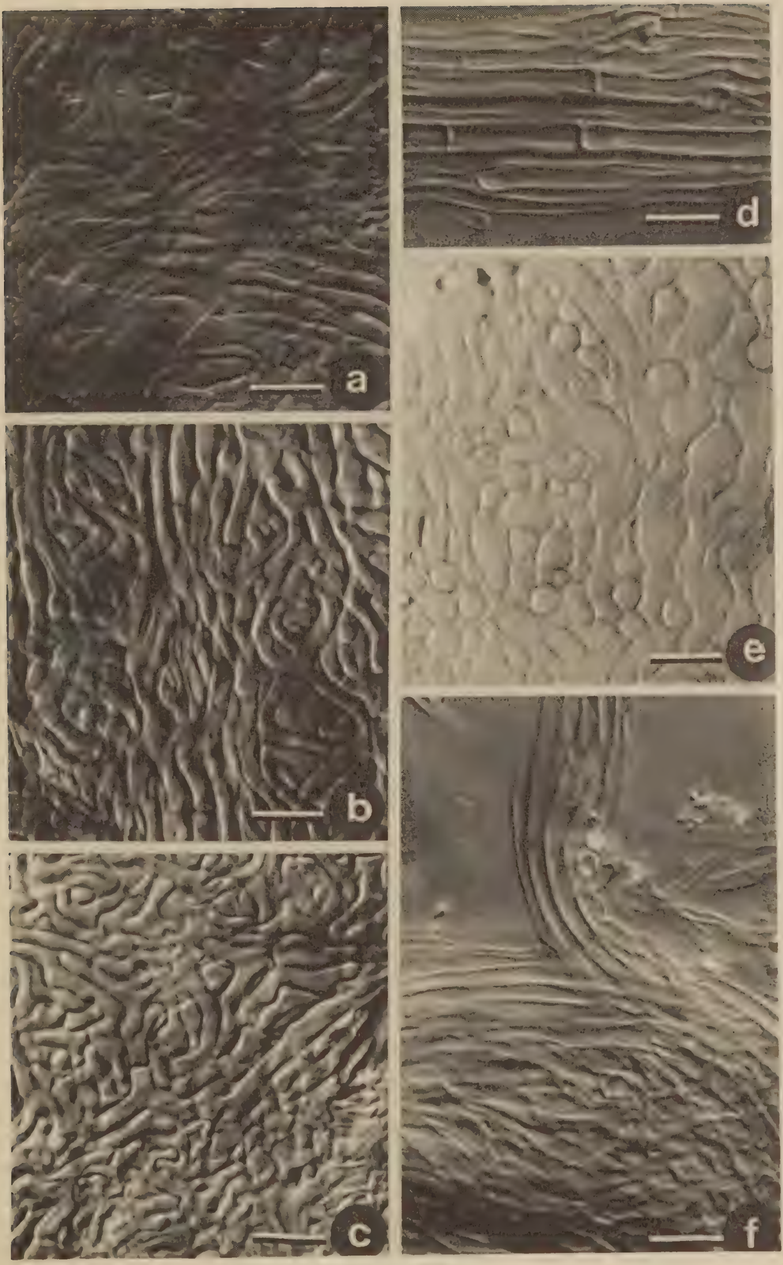
Fig. 7 *Tricholoma auratum*
a - c: Plan views of mantle from outside to inside, showing increasing density of hyphal arrangement; a)Surface view of mantle; b)Plan view of mantle, 5μm deeper than 7a; c)Plan view of mantle, 10-15μm deeper than 7a; d)Longitudinal section of rhizomorph; e)Cross section of rhizomorph showing hyphae of different diameter bot no larger central hyphae; f)Branching rhizomorph (all figs. from Herb. UM-D80; bar represents 10μm).

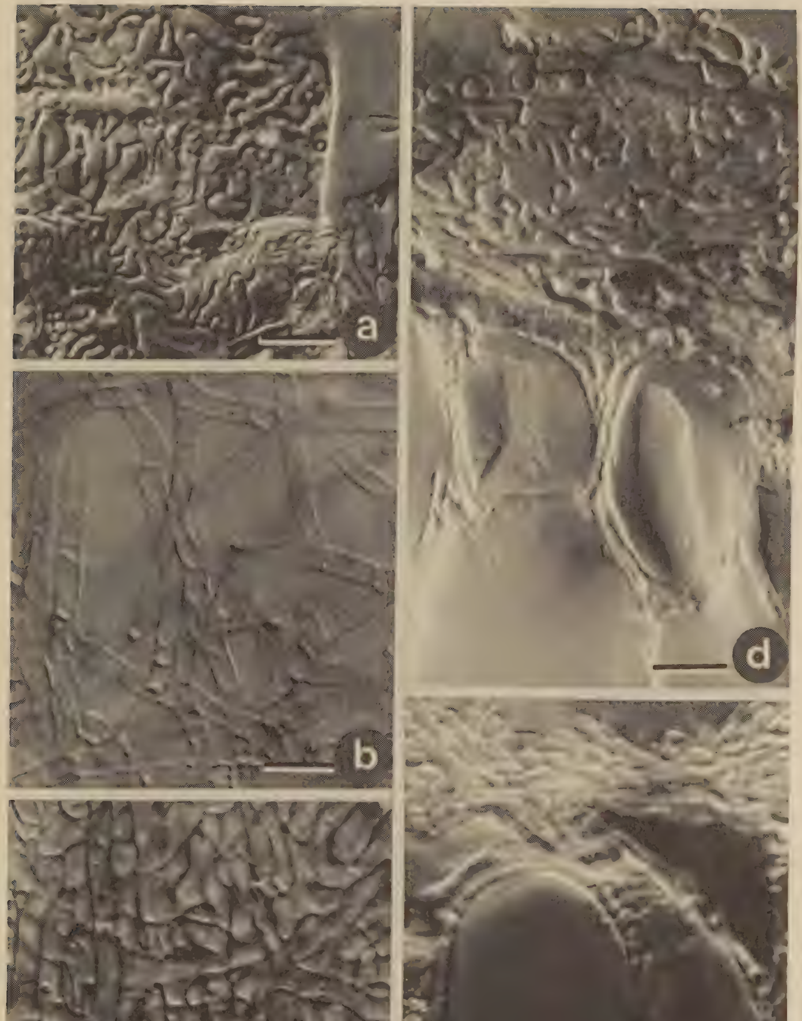

a
b
c
d
e
f

published.

III. Comparison of the Ectomycorrhizae of Tricholoma flavobrunneum and Tricholoma auratum

Morphological and anatomical characteristics Both mycorrhizae are whitish and densely stringy, plectenchymatous, and with conspicuous rhizomorphs. these differences regarding morphology seem only to be due to the two different hosts, for example the mode of ramification or diameter of branches, which both may be characteristics determined by the hosts. On the other hand there are differences between the two fungi. One of these is the rhizomorphal organization, which seems to divide the Tricholoma species in two groups as Agerer (1987a) pointed out. For example, Tricholoma flavobrunneum has differentiated rhizomorps with broad (8-10μm in diameter) central hyphae and narrow (4-6μm in diameter) outer hyphae, whereas Tricholoma auratum has less well differentiated rhizomorphs with both narrow (2-4μm in diameter) and broad (8(10)μm) hyphae but the latter are not centrally arranged. Another feature are the emanating hyphae of T. flavobrunneum are the thickened hyphal ends, that have a cap-like appearance. T. auratum lacks this characteristic. The Diameter of emanating hyphae in T.flavobrunneum is somewhat broader (4-6(7)μm) than that of T. auratum (2-4μm). Clamp connections are rare in T. flavobrunneum but totally absent in T. auratum. Contact septa and anastomoses are seen in T. flavobrunneum; only anastomoses are present in T. auratum. Finally, incrustations on the hyphae only are present in T. flavobrunneum.

Fig. 8 Tricholoma auratum
a)Inner surface of mantle; b)Emanating hyphae; c)Plan view of mantle, older parts of mycorrhizae; d)Cross section of mycorrhiza with mantle, tannin cells, cortical cells and Hartig net; e)Longitudinal section of mycorrhiza with mantle, tannin cells, cortical cells and Hartig net (all figs. from Herb. UM-D80; bar represents 10μm).


a
b
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d
e

Chemical reactions There is a significant difference in the reaction of the ectomycorrhizae of T. auratum and T.flavobrunneum to brillant-cresyl-blue. The ectomycorrhiza of T. auratum shows the typical reaction, i.e., blue after dying and slightly violet after washing with water. The ectomycorrhiza of T. flavobrunneum also is blue after dying, but on washing with water has violet emanating hyphae with reddish-violet incrustations and greenish mantle hyphae.

Autofluorescence The mantle of T. flavobrunneum has a slightly blue autofluorescence in UV and a greenish yellow fluorescence in blue light. There is no autofluorescence in the emanating hyphae, T. auratum has no autofluorescence in the mantle but slightly yellow autofluorescence in the emanating hyphae. No autofluorescence was seen in the rhizomorphs of either species. Additionally, tannin cells and outer rows of cortical cells of T. flavobrunneum show a reddish to yellowish red autofluorescence. This is absent in T. auratum.

IV. Mycorrhizae of the genus Tricholoma

The ectomycorrhizae of four Tricholoma species have been studied to date in this series: T. sulfureum and T. vaccinum, (Agerer 1987a), and T. flavobrunneum and T. auratum in the present study. All of them have in common a plectenchymatous structure, a more or less white mantle, and densely stringy surface with abundant rhizomorphs. On the other hand they do differ in certain characteristics. T. sulfureum mycorrhiza have distinct hyphal cell walls up to 0.5µm thick. The remaining three species have inconspicious cell walls. Contact-septa are present in T. sulfureum and T. flavobrunneum. Anastomoses are common in T. auratum but infrequent in T. vaccinum. Exclusive of T. auratum, which has no clamp connections, the hyphae of the other mycorrhizae may have clamp connections; however, they are infrequent. Another characteristic distinguishing these mycorrhizae is whether or not the structure of the rhizomorphs is differentiated. T. sulfureum and T. auratum mycorrhizae have rhizomorphs composed of densely interwoven hyphae. In T. sulfureum the rhizomorphs are not at all differentiated. The hyphae are loosely interwoven and are narrow ((2.5)3-4(5.5)µm in diameter) (Agerer 1987a). In *T. auratum* the hyphae are densely interwoven with both narrow and broad hyphae present, but the broad hyphae are not centrally arranged. The rhizomorphs of *T. flavobrunneum* and *T. vaccinum* mycorrhizae are well differentiated with conspicous central hyphae. The placement of *T. sulfureum* in a different subgenus than the other three species by Singer (1986) fits well with the data concerning its mycorrhizae (see key). A comparison of rootcell dimensions is given in Tab.1.

Tab.1 Comparison of root tannin and cor tical cell dimensions for the ectomycorrhizae of *T. auratum T. flavobrunneum,T. sulfureum and T. vaccinum*

species of fungus/host	**Cross Sect.**		**Long. Sect.**	
	***TCq**	***CCq**	***TCq**	***CCq**
T. flavobrunneum/ Betula pendula	**2,5**	**0,33**	**3,4**	**0,26**
T. auratum/ Pinus silvestris	5,6	**0,85**	5,1	**0,86**
T. sulfureum/ Picea abies	3,8	**1,5**	6,7	**3,1**
T. vaccinum/ Picea abies	5,7	**1,1**	7,4	**8**

*TCq=average ratio between tangential length and radial width of Tannin cells.
*CCq=average ratio between tangential length and radial width of Cortical cells.

The most striking differences can be seen in the last column of table 1, were CCq values in longitudinal section of the four *Tricholoma* mycorrhizae are compared. The low CCq of *T. flavobrunneum* is due to the palisade-like cortical cells of the birchectomycorhizae. The CCq-value near 1.0 (which means isodiametric cells) of *T. auratum* is due to the roundish cortical cells of *Pinus* mycorrhizae. CCq values of *Picea-Tricholoma* mycorrhizae are distinctly higher than 1.0, due to the tangentially elongated cortical-cells. The same tendencies were seen in previously published studies on Dermocybe (Uhl & Agerer 1987) and Rhizopogon (Uhl 1987). At this point it appears that CCq values of Picea mycorrhizae are distinctly higher than 1.0. Those of Pinus mycorrhizae are near 1.0 ; those of Fagus mycorrhizae between 0.3 and 0.9 (Brand F., pers.comm.), and Betula mycorrhizae distinctly less than 1.0. Comparing the CCq values of four Picea mycorrhizae, T. sulfureum and T. vaccinum (Agerer, 1987a) and D. cinnamomea and D. sanguinea (Agerer, 1987c), there is no apparent way to differentiate the fungus mycorrhizal species at the genus or species level regarding this feature. The value of "CCq in longitudinal section", up to now seems useful in differentiating the host species.

V. Key for the ectomycorrhizae of Tricholoma-species

The following key may help to compare the mycorrhizae of the Tricholoma species, studied to date.

1 Rhizomorphs not at all differentiated, i.e., hyphae looely interwoven and all narrow; cell walls up to 0.5µm thick; contact-septa present:
Tricholoma sulphureum
(Agerer 1987a)

1 Rhizomorphs differentiated in some way, i.e., with more distinctly arranged hyphae an/or with both narrow and broad hyphae; cell-walls < 0.5µm.
  2 Rhizomorphs with centrally arranged, broad hyphae;
    3 Central hyphae 8 -10µm in diameter:
    Tricholoma flavobrunneum
    3 Central hyphae 12-18µm in diameter:
    Tricholoma vaccinum
    (Agerer 1987a)
  2 Rhizomorphs with both narrow and braod hyphae; but the broad hyphae not centrally arranged:
  Tricholoma auratum

VI. Acknowledgements

I am very grateful to Dr.R. Agerer, Dr.F.H. Meyer and Dr.J.F. Ammirati, for their critical comments on the manuscript. This work is supported by a grant from the "Studienstiftung des deutschen Volkes".

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DICTYOCHAETA HETERODERAE, COMB. NOV.

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During a study of fungi colonizing cysts of *Heterodera glycines* Ichinohe in Illinois we isolated a fungus consistent with the description for *Codinea heteroderae* Morgan-Jones (Morgan-Jones, 1982). *Codinaea heteroderae* originally was isolated from decayed cysts of *H. glycines* in the southeastern United States by Gintis *et al.* (1982). Gamundi *et al.* (1977) redescribed the type species of *Dictyochaeta* Spegazinni, *D. fuegiana* Speg., and re-instated *Dictyochaeta* as an earlier name for *Codinaea* Maire. Hence, the following new combination is proposed for the species from nematode cysts:

Dictyochaeta heteroderae (Morgan-Jones) Carris & Glawe, *comb. nov.*

≡ *Codinaea heteroderae* Morgan-Jones, Mycotaxon 14: 175. 1982.

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LICHENS AND AIR QUALITY IN INDIANA DUNES NATIONAL LAKESHORE

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ABSTRACT

Over 350 lichens were collected at 24 localities in Indiana Dunes National Lakeshore to study the lichen fora with respect to air quality. Only 62 species were found compared to 110 reported for the nearby region in 1896. The present lichen flora of Indiana Dunes is severely damaged by air pollution. Less than 20% of the original 110 species are still present. There are no species left that are very sensitive to sulfur dioxide and the ones present are often in poor health or small or frequently without apothecia. There is no detectable species density gradient from west to east within the park as was reported earlier. Even further east in Warren Dunes State Park in southwestern Michigan there are only 8 species that are not in Indiana Dunes indicating that any species gradient extends over a much greater distance.

INTRODUCTION

Lichens are known to be very sensitive to low levels of many atmospheric pollutants. Some species are damaged or killed by annual average levels of sulfur dioxide as low as 13 ug/cubic meter (LeBlanc et al., 1972) or by nitrogen oxides, ozone and fluorides (Ross & Nash, 1983, Sigal & Nash, 1983, Eversman & Sigal, 1987). Other species are less sensitive and a few can tolerate levels of sulfur dioxide over 300ug/cubic meter (Laundon, 1967, Trass, 1973). The algae of the thallus are the first to be damaged in areas with air pollution and the first indication of damage is discoloring and death of the algae, which quickly leads to the death of the lichen. Lichens are more sensitive to air pollution when they are wet and physiologically active and are least sensitive when dry (Nash, 1973, Marsh & Nash, 1979). The nature of the substrate is also important in determining the sensitivity to sulfur dioxide since substrates with high pH buffer the fallout and permit the persistence of more sensitive species. After the lichen dies it disappears from the substrate within a few months to a year as it disintegrates and decomposes (Wetmore, 1982).

Contrary to some published reports (Medlin, 1985) there is little evidence that most lichens are good indicators of acid precipitation. However, Sigal & Johnston (1986) have reported that one species of Umbilicaria shows visible damage due to artificial acid rain. They also report that similar symptoms were found in collections from various localities in North America. No species of this genus were found in Indiana Dunes. Lechowicz (1987) reported that acid rain only slightly reduced growth of Cladina stellaris but Hutchinson et al. (1986) reported that extremely acid precipitation killed or damaged some mosses and lichens. Scott & Hutchinson (1987) showed temporary reduction of photosynthesis in Cladina stellaris and C. rangiferina after artificial acid rain.

This study attempted to assess the air pollution effects to the lichen flora of Indiana Dunes National Lakeshore by studying the lichen flora there today in comparison with historical records from the nearby area. The method is presented and discussed in more detail in Wetmore (1988a).

Indiana Dunes NL is located along the south shore of Lake Michigan just east of Chicago between Gary, Indiana and Michigan City, Indiana. The park was established in 1966 and has about 13,000 acres (5300 ha.) in several separated parcels of land. The park is in the middle of the urban and industrial area extending along southern Lake Michigan and many highways pass through and near the park. The park boundaries are artificial and were drawn to exclude most of the urban and developed land. In some cases the park is directly adjacent to developments and a steel plant is actually located between two parts of the park.

The entire park is on sand dunes in various stages of stabilization extending from the lakeshore with loose sand to mature oak forests at the south side of the park. Along the lakeshore the typical foredune herbaceous vegetation dominates but in in some areas white pines (Pinus strobus) occur to the base of the foredune at the lakeshore and oaks and cottonwoods (Populus deltoides) extend up the face. In most places, however, the forests begin just behind the top of the foredune. Black oak (Quercus velutina) dominates the drier sites on top and behind the dunes and red oak (Quercus borealis) occurs in more mesic sites. In some of the pannes there are ponds or swamps with standing water with Thuja occidentalis, Larix laricina and Fraxinus nigra while in other sites with less water there is red maple (Acer rubrum) forest. Blowouts are present in many places where trails extend across stabilized dunes. Fires are frequent in some areas of the park.

No historical lichen collections are known from the park so an accurate historical baseline for the park lichen flora is not available. Calkins (1896) studied the lichens around Chicago and listed 116 species in a paper that included the area in Cook, DuPage and northern Will Counties in Illinois and western Lake County in Indiana. The area covered in his paper included many habitats very similar to those in the park including prairies, lakeshores and woods of oak, elm, birch and maple. However, two of his localities had abundant rocks and one had calcareous soil. These two latter habitat types were not found in the park although occasional rocks and concrete were found. His substrates included stumps and posts as well as trees, rocks and soil. These same types of habitats and substrates are available in the park today so the Calkins paper has been used for historical comparisons.

Heiman and Apfelbaum (1984) did a preliminary vegetational study in the park and reported 11 lichens. They also stated that there was a gradient of species occurrence extending from west to east with more species at the eastern end of the park.

METHODS

Two weeks were spent in June, 1985 collecting in the park and 371 lichen collections were made at 24 localities (Fig. 1). Two additional collection sites were located in Warren Dunes State Park on the shore of Lake Michigan at the southwest corner of Michigan 35 miles (56 km) northeast of Indiana Dunes. Warren Dunes was selected to provide an area further downwind from Chicago to study the extent of the supposed pollution gradient. Localities for collecting were selected first to give a general coverage of the park, second, to sample all vegetational and substrate types, and third, to be in localities that should be rich in lichens. The collection localities included undisturbed areas as well as disturbed, such as gravel pits, roadsides and old fields. At some localities there are frequent groundfires. At each locality voucher specimens of all species found were collected to record the total flora for each locality and to avoid missing different species that might appear similar in the field. At some localities additional material of one species was collected for chemical analysis (see below). While collecting at each locality observations were made about the general health of the lichens.

The original packet of each collection has been deposited in the University of Minnesota Herbarium and representative sets of duplicates have been sent to the park and to the Smithsonian Institution. Label data for all specimens deposited at the University of Minnesota have been entered into the herbarium computerized data base.

LICHEN FLORA

The following list of lichens is based on my collections and those reported in the literature. This list includes 62 species I collected in Indiana Dunes, 42 of which are new records for the region. Of the 116 species given by Calkins (1896) 6 are probable misidentifications. All of the names reported by Calkins have been corrected according to current taxonomic concepts where possible. Some of the segregate genera in the Fifth Lichen Checklist (Egan, 1987) are not accepted here. Eight species were collected only at Warren Dunes. All but one of the species reported by Heiman and Apfelbaum were also collected by me in this study. There are three additional unidentified species found in the present study.

The species previously reported but not found in this study are placed in brackets. Species based on probable misidentifications and species found only at Warren Dunes are placed in separate lists at the end of the list for the park. The species found only once are noted in the list by "Rare". Those found also at Warren Dunes are noted "Warren Dunes". Species that occur only on rocks are indicated by "Rocks". In the first columns the letters indicate the sensitivity to sulfur dioxide, if known, according to the categories proposed by Wetmore (1983): S=Sensitive, I=Intermediate, T=Tolerant. S-I is intermediate between Sensitive and Intermediate and I-T is intermediate between Intermediate and Tolerant. Species in the Sensitive category are absent when annual average levels of sulfur dioxide are above 50µg per cubic meter. The Intermediate category includes those species present between 50 and 100µg and those in the Tolerant category are present at over 100µg per cubic meter.

	[*Acarospora fuscata* (Nyl.) Arn. (Calkins, 1896) Rocks]
	Acarospora immersa Fink Rare Rocks
I	[*Acrocordia gemmata* (Ach.) Mass. (Calkins, 1896)]
I	*Anisomeridium biforme* (Borr.) R. Harris Rare
	[*Anzia colpodes* (Ach.) Stizenb. (Calkins, 1896)]
	Arthonia caesia (Flot.) Körb. (Calkins, 1896, Heiman & Apfelbaum, 1984) Warren Dunes
	[*Arthonia diffusa* Nyl. (Calkins, 1896)]
	[*Arthonia pyrrhuliza* Nyl. (Calkins, 1896)]
I	[*Arthonia radiata* (Pers.) Ach. (Calkins, 1896)] Warren Dunes only
	[*Arthopyrenia punctiformis* Mass. (Calkins, 1896)]
	[*Arthothelium spectabile* Flot. ex Mass. (Calkins, 1896)]
	[*Arthothelium taediosum* (Nyl.) Müll. Arg. (Calkins, 1896)]
	[*Aspicilia calcarea* (L.) Mudd (Calkins, 1896) Rocks]
	[*Aspicilia contorta* (Hoffm.) Kremp. (Calkins, 1896) Rocks]
	[*Bacidia inundata* (Fr.) Körb. (Calkins, 1896) Rocks]
	[*Bacidia polychroa* (Th. Fr.) Körb. (Calkins, 1896)]
I	[*Bacidia rubella* (Hoffm.) Mass. (Calkins, 1896)]
	[*Bacidia suffusa* (Fr.) Schneid. (Calkins, 1896)]
	[*Biatorella cyphalea* (Tuck.) Zahlbr. (Calkins, 1896)]
	[*Buellia disciformis* (Fr.) Mudd (Calkins, 1896)]
T	*Buellia punctata* (Hoffm.) Mass.
	[*Buellia schaereri* De Not. (Calkins, 1896)]
S-I	*Caloplaca cerina* (Ehrh. ex Hedw.) Th. Fr. Rare, Warren Dunes
	[*Caloplaca cinnabarina* (Ach.) Zahlbr. (Calkins, 1896) Rocks]
	Caloplaca feracissima Magn. Rare Rocks
	[*Caloplaca ferruginea* (Huds.) Th. Fr. (Calkins, 1896)]
S	[*Caloplaca flavorubescens* (Huds.) Laund. (Calkins, 1896)]
	[*Caloplaca microphyllina* (Tuck.) Hasse (Calkins, 1896)]
S-I	*Candelaria concolor* (Dicks.) B. Stein (Calkins, 1896) Warren Dunes
	Candelariella efflorescens R. Harris & Buck Rare
I	[*Candelariella vitellina* (Hoffm.) Müll. Arg. (Calkins, 1896)]

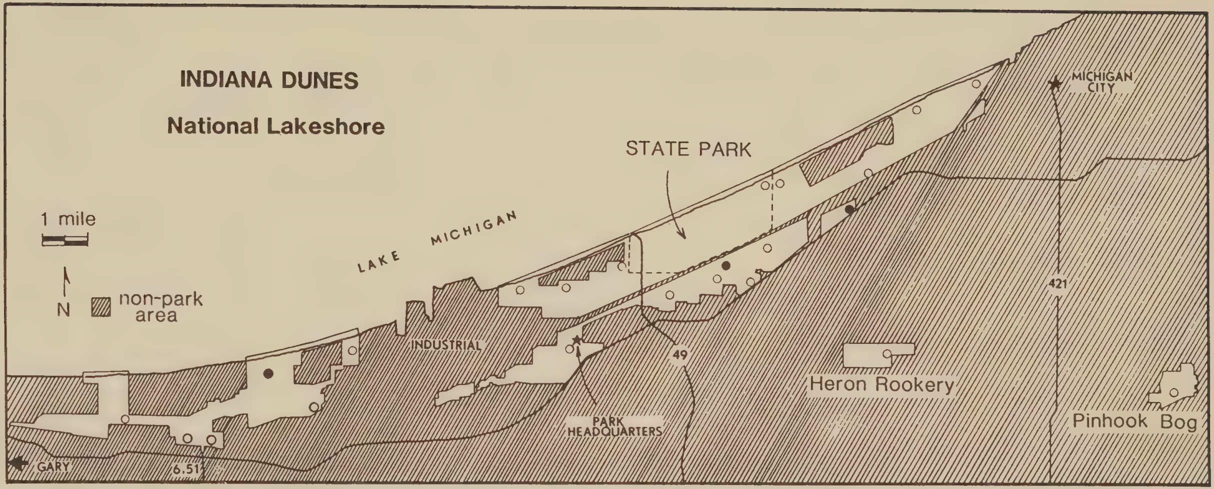
INDIANA DUNES
National Lakeshore
1 mile
N
non-park area
LAKE MICHIGAN
STATE PARK
MICHIGAN CITY
421
INDUSTRIAL
49
PARK HEADQUARTERS
Heron Rookery
Pinhook Bog
GARY
6.51

Fig. 1. Location of collection localities. Open circles are collection localities, filled circles are also elemental analysis localities.

S-I *Candelariella xanthostigma* (Ach.) Lett. Warren Dunes
[*Catapyrenium lachneum* (Ach.) R. Sant. (Calkins, 1896)]
S-I [*Cetraria ciliaris* Ach. (Calkins, 1896)]
Cladina mitis (Sandst.) Hustich Rare
Cladina rangiferina (L.) Nyl. Rare (Calkins, 1896)
Cladonia bacillaris Nyl.
Cladonia bacilliformis (Nyl.) Glück Rare
Cladonia caespiticia (Pers.) Flörke Rare
Cladonia verticillata (Hoffm.) Schaer. (Calkins, 1896)
Cladonia chlorophaea (Flörke ex Somm.) Spreng. Warren Dunes
I *Cladonia coniocraea* (Flörke) Spreng. (Heiman & Apfelbaum, 1984)
I *Cladonia cristatella* Tuck. (Calkins, 1896) Warren Dunes
Cladonia cryptochlorophaea Asah.
Cladonia cylindrica (Evans) Evans Rare
S-I *Cladonia fimbriata* (L.) Fr. Rare (Calkins, 1896)
[*Cladonia furcata* (Huds.) Schrad. (Calkins, 1896)]
[*Cladonia gracilis* (L.) Willd. (Calkins, 1896)]
Cladonia grayi G. K. Merr. ex Sandst.
[*Cladonia macilenta* Hoffm. (Calkins, 1896)]
[*Cladonia parasitica* (Hoffm.) Hoffm. (Calkins, 1896)]
Cladonia peziziformis (With.) Laundon (Calkins, 1896) Warren Dunes
Cladonia pleurota (Flörke) Schaer.
Cladonia polycarpoides Nyl.
Cladonia pyxidata (L.) Hoffm. (Calkins, 1896) Warren Dunes
Cladonia ramulosa (With.) Laundon Rare
Cladonia rei Schaer. Warren Dunes
[*Cladonia squamosa* (Scop.) Hoffm. (Calkins, 1896)]
Cladonia strepsilis (Ach.) Vain.
[*Collema auriforme* (With.) Coppins & Laundon (Calkins, 1896) Rocks]
[*Collema conglomeratum* Hoffm. (Calkins, 1896)]
[*Collema flaccidum* (Ach.) Ach. (Calkins, 1896)]
[*Collema fragrans* (Sm.) Ach. (Calkins, 1896)]
[*Collema limosum* (Ach.) Ach. (Calkins, 1896)]
[*Collema tenax* (Sw.) Ach. (Calkins, 1896)]
[*Conotrema urceolatum* (Ach.) Tuck. (Calkins, 1896)]
[*Dermatocarpon miniatum* (L.) Mann (Calkins, 1896) Rocks]
Diploschistes scruposus (Schreb.) Norm. (Calkins, 1896) Rare Warren Dunes
Endocarpon pusillum Hedw. (Calkins, 1896) Rare Rocks
I *Evernia mesomorpha* Nyl. Rare
I [*Graphis scripta* (L.) Ach. (Calkins, 1896)] Warren Dunes only
[*Heppia lutosa* (Ach.) Nyl. (Calkins, 1896)]
[*Heterodermia granulifera* (Ach.) W. Culb. (Calkins, 1896)]
[*Heterodermia speciosa* (Wulf.) Trev. (Calkins, 1896)]
I [*Hyperphyscia adglutinata* (Flörke) Mayrh. & Poelt (Calkins, 1896)]
I [*Hypogymnia physodes* (L.) Nyl. (Calkins, 1896)]
I [*Imshaugia aleurites* (Ach.) S. F. Meyer (Calkins, 1896)]

[*Lecania erysibe* (Ach.) Mudd (Calkins, 1896) Rocks]
[*Lecania perproxima* (Nyl.) Zahlbr. (Calkins, 1896) Rocks]
I [*Lecanora allophana* Nyl. (Calkins, 1896)]
[*Lecanora argentata* (Ach.) Malme (Calkins, 1896)]
T *Lecanora dispersa* (Pers.) Somm. Rare Rocks
T *Lecanora hagenii* (Ach.) Ach. (Calkins, 1896) Rare
I [*Lecanora pallida* (Schreb.) Rabenh. (Calkins, 1896)]
[*Lecanora populicola* (DC. in Lam. & DC.) Duby (Calkins, 1896)]
I *Lecanora saligna* (Schrad.) Zahlbr. (Heiman & Apfelbaum, 1984)
[*Lecanora sambuci* (Pers.) Nyl. (Calkins, 1896)]
I [*Lecanora symmicta* (Ach.) Ach. (Calkins, 1896)] Warren Dunes only
Lecanora thysanophora Harris ined. Rare
[*Lecanora varia* (Hoffm.) Ach. (Calkins, 1896)]
[*Lecidea varians* Ach. (Calkins, 1896)]
Lepraria finkii (B. de Lesd. in Hue) R. Harris
[*Leptogium chloromelum* (Sw. ex Ach.) Nyl. (Calkins, 1896)]
[*Leptogium corticola* (Tayl.) Tuck. (Calkins, 1896)]
[*Leptogium lichenoides* (L.) Zahlbr. (Calkins, 1896)]
[*Leptogium saturninum* (Dicks.) Nyl. (Calkins, 1896)]
[*Leptorhaphis epidermidis* (Ach.) Th. Fr. (Calkins, 1896)]
Micarea prasina Fr. Rare
I [*Opegrapha atra* Pers. (Calkins, 1896)]
S-I [*Opegrapha varia* Pers. (Calkins, 1896)]
Parmelia bolliana Müll. Arg. Warren Dunes
[*Parmelia borreri* (Sm.) Turn. (Calkins, 1896)]
I *Parmelia caperata* (L.) Ach. (Calkins, 1896)
[*Parmelia cetrata* Ach. (Calkins, 1896)]
S [*Parmelia coniocarpa* Laurer (Calkins, 1896)]
[*Parmelia conspersa* (Ach.) Ach. (Calkins, 1896) Rocks]
[*Parmelia crinita* Ach. (Calkins, 1896)]
Parmelia flaventior Stirt.
[*Parmelia galbina* Ach. (Calkins, 1896)]
[*Parmelia perforata* (Jacq.) Ach. (Calkins, 1896)]
I *Parmelia rudecta* Ach. (Calkins, 1896, Heiman & Apfelbaum, 1984) Warren Dunes
S [*Parmelia squarrosa* Hale (Calkins, 1896)]
(S) *Parmelia subaurifera* Nyl. Rare
I-T *Parmelia sulcata* Tayl. (Calkins, 1896, Heiman & Apfelbaum, 1984) Warren Dunes
Peltigera rufescens (Weis.) Humb. (Calkins, 1896) Rare Warren Dunes
[*Pertusaria leucostoma* (Bernh.) Mass. (Calkins, 1896)]
[*Pertusaria pustulata* (Ach.) Duby (Calkins, 1896)]
[*Pertusaria velata* (Turn.) Nyl. (Calkins, 1896)]
Phaeophyscia cernohorskyi (Nadv.) Essl. Rare
Phaeophyscia chloantha (Ach.) Moberg Warren Dunes
Phaeophyscia ciliata (Hoffm.) Moberg (Calkins, 1896) Rare
Phaeophyscia pusilloides (Zahlbr.) Essl.
Phaeophyscia rubropulchra (Degel.) Moberg (Heiman & Apfelbaum, 1984) Warren Dunes

I *Physcia adscendens* (Th. Fr.) Oliv. Warren Dunes
I [*Physcia aipolia* (Ehrh. ex Humb.) Fürnr. (Calkins, 1896)] Warren Dunes only
I *Physcia millegrana* Degel. (Calkins, 1896, Heiman & Apfelbaum, 1984) Warren Dunes
I *Physcia stellaris* (L.) Nyl. (Calkins, 1896) Warren Dunes
I *Physconia detersa* (Nyl.) Poelt Rare Warren Dunes
Placynthiella icmalea (Ach.) Coppins & James
Placynthiella oligotropha (Laund.) Coppins & James Rare
[*Placynthium nigrum* (Huds.) Gray (Calkins, 1896) Rocks]
[*Pyrenocollema prospersella* (Nyl.) R. Harris (Calkins, 1896) Rocks]
[*Pyrenula laevigata* (Pers.) Arn. (Calkins, 1896)]
S [*Ramalina americana* Hale (Calkins, 1896)]
S [*Ramalina calicaris* (L.) Fr. (Calkins, 1896)]
S [*Ramalina fraxinea* (L.) Ach. (Calkins, 1896)]
[*Rinodina bischoffii* (Hepp) Mass. (Calkins, 1896) Rocks]
[*Sarcogyne privigna* (Ach.) Mass. (Calkins, 1896) Rocks]
[*Sarcogyne regularis* Körb. (Calkins, 1896) Rocks]
I *Scoliciosporum chlorococcum* (Graewe ex Stenh.) Vezda (Heiman & Apfelbaum, 1984) Warren Dunes
[*Teloschistes chrysophthalmus* (L.) Th. Fr. (Calkins, 1896)]
[*Thelidium pyrenophorum* (Ach.) Mudd (Calkins, 1896) Rocks]
Thelocarpon laureri (Flot.) Nyl. Rare
[*Trapelia coarctata* (Sm.) Choisy in Werner (Calkins, 1896) Rocks]
Trapelia involuta (Tayl.) Hert. Rare Rocks
Trapeliopsis flexuosa (Fr.) Coppins & P. James
[*Verrucaria fuscella* (Turn.) Winch (Calkins, 1896) Rocks]
Verrucaria muralis Ach. (Calkins, 1896) Rocks
[*Verrucaria nigrescens* Pers. (Calkins, 1896) Rocks]
[*Verrucaria viridula* (Schrad.) Ach. (Calkins, 1896) Rocks]
S-I *Xanthoria fallax* (Hepp in Arn.) Arn. (Calkins, 1896)
I [*Xanthoria polycarpa* (Hoffm.) Rieber (Calkins, 1896, Heiman & Apfelbaum, 1984)] Warren Dunes only

The following species were collected only in Warren Dunes State Park, Berrien Co., Michigan.

Arthonia dispersa (Schrad.) Nyl.
I *Arthonia radiata* (Pers.) Ach.
Catillaria nigroclavata (Nyl.) Schuler
I *Graphis scripta* (L.) Ach.
I *Lecanora symmicta* (Ach.) Ach.
Parmelia aurulenta Tuck.
I *Physcia aipolia* (Ehrh. ex Humb.) Fürnr.
I *Xanthoria polycarpa* (Hoffm.) Rieber

The following species were reported by Calkins (1896) but are probable misidentifications for North American material or are of uncertain placement.

Lecidea enteroleuca auct. = Lecidella sp.
Mycomicrothelia thelena (Ach.) Trev.
Pertusaria multipuncta (Turn.) Nyl.
Pertusaria pertusa (L.) Tuck.
Pyrenula nitida (Weig.) Ach.
Rinodina sophodes (Ach.) Mass.

DISCUSSION OF FLORA

The lichen flora of the park is not rich but there are some localities with microhabitats suitable for the lichens requiring more moisture. Examples are Cowles Bog where Thuja occidentalis, Larix laricina and Fraxinus spp. occur and Pinhook Bog where several rare vascular plants and mosses have been found. There are always fewer lichens in northern hardwood forests, partly due to the dense shade. Before widespread air pollution this region of the country had a relatively poor lichen flora (Calkins, 1896) but even in his time Calkins mentioned the reduction of the lichen flora around Chicago. Now the lichen flora is only a fraction of what it was in the last century.

Of the 110 identifiable species reported by Calkins in 1896, only 20 (18%) were found in the park in 1985 and the other 90 species (82%) were not found. Calkins did find more rock substrates than are present in the park but there are some rocks present in the park and some saxicolous species were found in this study. If all of the saxicolous species are eliminated from the list, there still has been a loss of 80% of the species. All of the species most sensitive to sulfur dioxide are gone and also many in the S-I and I groups. The most common species are Physcia millegrana, Cladonia cristatella and Parmelia sulcata and these are relatively tolerant to sulfur dioxide. The only remaining species in the S category is Parmelia subaurifera, but this species probably belongs in the S-I category. All but one of the 13 cyanophilic species reported by Calkins are gone. Sheridan (1979) and Henriksson & Pearson (1981) reported that nitrogen fixation in cyanophilic lichens is very sensitive to sulfur dioxide.

Several species are in poor health and show growth abnormalities that are similar to known damage by sulfur dioxide such as bleached and dying lobes and often with somewhat distorted growth. Some species, such as Arthonia caesia, that usually are fertile are frequent in Indiana Dunes but are almost always without apothecia. Lichens are not abundant at any locality and most species are represented by small thalli, often near the bases of the trees where sulfur dioxide levels are probably lower.

Some of the 42 new records represent species that were overlooked by Calkins or were reported under different names, and some are due to changes in species concepts, and some may have migrated into the area during the past 80 years. Adding these new records to the 110 identifiable species reported by Calkins provides a total potential lichen flora of 152 species.

With no historical records from a park it is difficult to accurately determine the change in the lichen flora. This is similar to the situation in the Cuyahoga Valley National Recreation Area in Ohio (Wetmore, 1988b) where there are no historical records from the park and high regional air pollution. In the Indiana Dunes study the nearby area studied by Calkins provides the next best baseline for comparison. Calkins collected along the lakeshore and streams and on trees in the prairies. Most of the species found by Calkins in those habitats were probably also present in similar habitats in Indiana Dunes in 1896. Most of these types of habitats, with the exception of the rocks and calcareous soils, are present in the park today. The habitats in the park probably have not changed much in the past 80 years because the park boundaries excluded the urban and developed land. Henry C. Cowles did some of his pioneering ecological studies in the 1890's in what is now the park and many of these habitats have not been disturbed since his studies. In the absence of historical collections from the park it seems reasonable to compare the species collected by Calkins with the present lichen flora.

These observations indicate that there has been substantial decrease in the lichen flora over the past 90 years. Many species have been eliminated, the remaining species are tolerant to sulfur dioxide, are small and often with distorted growth and with lower fertility. This species impoverishment extends all the way to Warren Dunes in Michigan because only a few additional species were found there but nowhere near the number to be expected in a clean area. Because of the known air pollution in the Chicago area, this is probably is the cause of the loss of species in the park. Sulfur dioxide and ozone are probably the most important pollutants.

Heiman & Apfelbaum (1984) reported a species density gradient from east to west in the park with more species in the east. With more thorough collecting it is apparent that there is no gradient in species numbers within the limits of the park. Miller Woods at the west end of the park has 10 species and Mt. Baldy at the east end has 12 species. This difference is not significant. Miller woods has fewer lichens because it is very frequently burned and this radically reduces lichen abundance (Wetmore, 1981). In contrast, Mt. Baldy is very shady with much underbrush and this contributes to lichen scarcity. The best area for lichens was Howes Prairie near the center of the park with 23 species. This locality has open woods a greater diversity of tree species and with some low areas, all contributing to providing a better lichen habitat. The numbers of species in the more sensitive sulfur dioxide categories is not significantly different at the different localities. If there were a strong air pollution gradient from west to east one would expect to see an increase in numbers of more sensitive species at the eastern end of the park. This seems to indicate that the air pollution is over a broad area and any concentration gradient extends much further east than is included in Indiana Dunes and even extends beyond Warren Dunes.

ELEMENTAL ANALYSIS

An important method of assessing the effects of air quality is by examining the elemental content of the lichens (Nieboer et al, 1972, 1977, 1978; Erdman & Gough, 1977; Puckett & Finegan, 1980; Nash & Sommerfeld, 1981). Elevated but sublethal levels of sulfur or other elements might indicate incipient damaging conditions.

METHODS

Lichen samples of one species were collected in spunbound olefin sample bags at three localities in different parts of the park for laboratory analysis. Cladonia cristatella was the only species abundant enough and suitable for cleaning. This species grows on soil and is not especially good to use but was the only one available. Three localities were selected to represent the geographical extremes of the park and are indicated on the map of collection localities. These localities are: West Beach at the western end of the park, north of Furnessville Road near the center of the park, and south of Beverly Shores near the eastern end of the park. Ten to 20 grams of each species were collected at each locality.

Lichens were air dried and cleaned of all sand under a dissecting microscope but thalli were not washed. Three samples of each collection were submitted for analysis. Analysis was done for sulfur and multi-element analysis by the Research Analytical Laboratory at the University of Minnesota. In the sulfur analysis a ground and pelleted 100-150mg sample was prepared for total sulfur by dry combustion and measurement of evolved sulfur dioxide on a LECO Sulfur Determinator, model no. SC-132, by infra red absorption. Multi-element determination for Ca, Mg, Na, K, P, Fe, Mn, Al, Cu, Zn, Cd, Cr, Ni, Pb, and B were determined simultaneously by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry. For the ICP one gram of dried plant material was dry ashed in a covered 20 ml high form silica crucible at 485 degrees Celsius for 10-12 hrs. The dry ash was boiled in 2N HCl to improve the recovery of Fe, Al and Cr and followed by transfer of the supernatant to 7 ml plastic disposable tubes for direct determination by ICP.

RESULTS AND DISCUSSION

Table 1 gives the means and standard deviations for the three replicates at each locality and data for Cladonia cristatella from Cedar Creek, Minnesota (a clean area north of Minneapolis) for comparison. All reported values are above the lower detection limits of the instruments. There are no literature reports of elemental analysis of this species but all of the levels found in the Indiana Dunes lichens are within typical limits for similar lichens. However, accumulation rates differ from species to species so accurate comparisons are not possible.

Table 1. Summary of analysis of *Cladonia cristatella* from Indiana Dunes. Values in ppm of thallus.

	P	K	Ca	Mg	Al	Fe	Na	Mn	Locality
Mean	615	2245	690	483	572	1542	58.2	61.4	West Beach
SD	21	78	29	24	19	51	3.4	0.8	West Beach
Mean	916	2451	492	328	501	847	38.7	40.0	Furnessville
SD	53	160	10	5	8	52	3.1	1.4	Furnessville
Mean	898	2681	455	318	470	632	35.2	26.9	Beverly Sh.
SD	42	113	12	13	16	17	2.6	0.1	Beverly Sh.
Mean	885	2511	657	372	629	586	39.7	21.1	Cedar Creek

	Zn	Cu	B	Pb	Ni	Cr	Cd	S	Locality
Mean	53.6	10.3	3.2	20.8	1.4	3.3	0.3	1487	West Beach
SD	1.0	0.8	0.2	0.4	0.2	0.1	<.1	78	West Beach
Mean	35.9	8.1	2.6	15.5	1.2	2.0	0.2	983	Furnessville
SD	1.6	0.1	0.1	1.6	0.1	0.2	<.1	47	Furnessville
Mean	33.3	9.0	2.7	10.2	1.1	1.3	0.2	1030	Beverly Sh.
SD	0.8	0.5	0.2	0.5	0.1	0.1	<.1	26	Beverly Sh.
Mean	20.3	4.2	1.5	9.3	1.4	1.0	0.2	792	Cedar Creek

The mean sulfur levels range from 983 to 1487ppm for all samples but levels at Cedar Creek are somewhat lower than in Indiana Dunes. The sulfur levels in collections from West Beach (on the western side of the park) are significantly higher than the other two localities in Indiana Dunes. Some of the other elements are also higher at Western Beach (Fe, Na, Mn, Zn, Cu and Pb). These are all pollutants from the industrial areas within and to the west of the park. Copper and lead also show a gradient within the park decreasing toward the east.

Inman & Parker (1978) studied metals in the soils of several localities in northwesten Indiana and found higher levels of Zn, Cd, Pb and Cu in the northern urban soils than in more southern localities. They found slower decomposition rates on polluted soils than on clean soils. No soil was analysed from Indiana Dunes localities in the present study but it may be assumed that pollutant levels in these soils are elevated also. Seaward & Bylinska (1980) did not show a correlation between levels of Pb, Cr, Ni, Cu, Mn and Zn in the soils and levels in lichens growing on them. However, LeRoy & Koksoy (1962) found a correlation between lichen levels and substrate levels of some elements in Colorado. The higher levels of some elements in the lichens from Indiana Dunes found in this study and the higer levels found in the soils from Inman & Parker (1978) probably both came from atmospheric fallout and the levels in the lichens analysed probably reflect this airborn input rather than the indirect pathway through the soil.

The National Park Service has had a sulfur dioxide monitor in service since 1981 at the park headquarters near Porter, Indiana, but valid annual averages are only available for 1983 and 1986. In 1983 the annual arithmetic average was 18ug/cubic meter and in 1986 the annual arithmetic average was 17ug/cubic meter. These figures are at the lower limits for damage to the most sensitive species of lichens. However, 5% of the sampling hours in every year (1981-1986) were above 50µg/cubic meter and 1% of the hours for each year were above 110µg/cubic meter and one hour maxima for each year were above 340µg/cubic meter. The amount of damage depends on the length of the period and the moisture conditions of the thallus at the time. No data are available on moisture conditions at the times of high instrument readings.

Sulfur dioxide levels probably were higher in the past and eliminated many species. Because of the broad regional air pollution the nearest source of propagules may be so far away that there has been insufficient time for recolonization by those species that might be able to tolerate present levels of pollutants. Transplant studies would be needed to determine whether some of the lost species could survive in the park today.

CONCLUSIONS

In spite of the fact that the historical comparisons are made with a regional list, the similarities in vascular plant vegetation indicate that the comparisons are valid for the non-saxicolous lichen species. With 80% of the historical species absent, including all of the species most sensitive to sulfur dioxide and the cyanophilic lichens, drastic changes have occurred in the park. The habitats studied in 1985 were generally unchanged from 90 years ago. With the known air pollution in the area and the higher sulfur levels in the elemental analysis, the logical cause is increased sulfur dioxide in the air. This is the same as in Cuyahoga Valley National Recreation Area in Ohio (Wetmore, 1988b) where there is heavy regional air pollution and 79% of the historical species are no longer present. There are no old historical lichen records from either park but these studies document the present lichen floras and provide a baseline for future studies.

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CALOCYBE FALLAX: ITS ECOLOGY AND CULTURAL BEHAVIOR

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SUMMARY

Fruiting bodies of *Calocybe fallax*, a new species from Alaska, were frequently observed during the summer and fall of 1987 in an *Alnus crispa* stand 55 km NNW of Fairbanks, Alaska (USA). The main fructification period occurred in September, two to three weeks after heavy rainfalls, and after the minimum and mean temperatures dropped about 11 and 7°C, respectively. More new ecological data are presented.

Cultures obtained from pileus-tissue and single germinated basidiospores were successfully grown on malt agar. Thallic-arthric conidia developed in culture from primary and secondary mycelia and are reported in *Calocybe* for the first time. Conidia produced by primery mycelia are uninucleate but conidia produced by secondary mycelia are binucleate. Thallic-arthric conidia were not on the fruiting bodies nor were they observed on the surrounding mycelium.

INTRODUCTION

During myco-ecological studies in different alder stands near Fairbanks, Alaska (USA), in the summer of 1987, a small orange yellow agaric with white spores was observed frequently in an *Alnus crispa* (Ait.) Pursh stand. The siderophilous granulations in the mature basidia, coloration of the fruiting bodies and the hymenidermal pileipellis left no doubt that this taxon is *Calocybe fallax* (Sacc.) Singer ex Redhead & Singer. The characteristics which distinguish this species from others of the section Pseudoflammulae Singer (Singer, 1986) are the orange yellow to brownish yellow color of the fruiting bodies (absence of pink, red, violet, blue or olive colors) and the mild taste. *C. caucasica* Singer (Singer, 1961) is similar, but it has somewhat different pileus coloration. There is insufficient additional anatomical data to make a judgement concerning how closely it is to *C. fallax*. It is noteworthy that *C. caucasica* was not included in his key to the species of *Calocybe* (Singer, 1977).

All of our dikaryotic pure cultures of *C. fallax* produced thallic-arthric conidia. This is the first report of conidial production for any species of *Calocybe*. However, two species of *Lyophyllum* are known to produce chlamydospores in culture (Clémençon, 1968). The production of thallic-arthric conidia has been reported for several different taxa of saprobic species in the families Tricholomataceae, Pleurotaceae, Strophariaceae, Coprinaceae, Bolbitiaceae and Cortinariaceae (Kendrick & Watling, 1979). In the Tricholomataceae thallic-arthric conidia production has been described in *Armillaria*, *Arthrosporella*, *Collybia*, *Crinipellis*, *Flagelloscypha*, *Flammulina*, *Marasmius*, *Mycena* and *Strobilurus*.

MATERIAL AND METHODS

The study area is located near the Elliott Highway, milepost 40, 55 km NNW Fairbanks, Alaska (65°30′N/149°80′W, elevation 400 m). The site has a SSW exposure and the slope is 20%. The vegetation is a nearly homogenous *Alnus crispa* thicket (height 3-5 m, age 20-33 years), with a few interspersed *Betula papyrifera* Marsh (height 8-10 m, age 35-54 years). The soil is a typical cryochrept (Rieger *et al.*, 1979), well-drained, gravelly and with a loamy texture. Within the upper 10 cm gravel content (> 2 mm diam) ranges between 0-10%, bulk density between 0.2-1.2 g/cm^3, pH(H_2O) between 4.6-4.8 and organic matter content between 3.2-21.9%. Precipitation was measured weekly in the stand and in a clearing using rain gauges in each location elevated 39 cm above the ground. Also, minimum and maximum thermometers and two thermographs (ML-77, Friez Instrument Division) in shaded boxes at 98 cm height were used to record weekly temperature. The thermographs measured the air temperature continuously within the stand and the clearing, and they were used to determine the weekly mean temperature. Since much data had to be recorded on such stand, it was necessary to sample a small number of plots. Therefore, two permanent 10 x 100 m plots, divided in 2 x 2 m squares, were established in the alder stand during the growing season (June 2nd to September 10th, 1987).

Tissue blocks from the pileus context were placed on 2% malt agar (MA) and incubated in the dark at 20°C. From the mycelium growing onto the new agar transfers were made and placed on new MA in order to determine the growth rate and thallic-arthric conidial production. Conidial formation was observed on slide cultures. Spore prints were obtained in empty Petri dishes by placing Vaseline on a pileus severed from the stipe and sticking it to a Petri dish lid overnight. The lid was changed after successful spore drops and the plate stored in the dark at 4°C. Single spore isolations were made by wetting the spores with 4 μl of sterile water. A suspension of spores was then pipetted on MA. The spores were separated using a sterilized bent glass rod on a Petri dish turntable. The same method was used to inoculate single conidial isolations from conidia produced in cultures on MA. Spore and conidial dilutions were incubated in the dark at 20°C.

Nuclear staining of conidia with acetocarmine was carried out as described by Clémençon (1968), but FAA (2 parts formaldehyde, 1 part acetic acid, 10 parts 95% ethyl alcohol, 7 parts water) was used instead of Newcomers fixing fluid. Extracellular enzyme production was tested by utilizing syringaldazine (specific for laccase), gum guaiac (nonspecific for laccase and tyrosinase) and phenol (specific for tyrosinase) according to Marr (1979).

Drawings of spores, basidia, cystidia and the pileipellis were made with the aid of a Leitz drawing tube and a 40x or a 100x oil immersion objective. Photomicrographs were made with a Leitz ortholux automatic camera. Colors are those used by Kornerup & Wanscher (1978).

RESULTS

Taxonomy

Calocybe fallax (Sacc.) Singer ex Redhead & Singer, Mycotaxon *6*: 501. 1978 (Fig. 1).
≡ *Agaricus fallax* Peck, Bull. Buffalo Soc. Nat. Sci. *1*: 44. 1873.
≡ *Tricholoma fallax* (Peck) Sacc., Syll. Fung. *5*: 115. 1887.
non *Agaricus fallax* Lasch, Linnaea *4*: 524. 1829.

Pileus: 0.6-2.7 cm broad, convex to umbonate to depressed in age, margin incurved at first to plane in age, glabrous, hygrophanous, orange yellow to greyish yellow to brownish yellow; flesh thick under the disc, light yellow; odor none, taste mild. Lamellae: crowded, 28-54, narrow to broad, sharply adnexed to sinuate, light yellow to brownish yellow; lamellulae 1-3, same color as lamellae. Stipe: 1.7-3.7 cm long, 1-5 mm broad, equal, glabrous or sometimes coated with white to light yellow fibrils, solid at first to hollow in age, apex yellow and pruinose; base covered with white felt-like mycelium; flesh light yellow to brownish yellow. Spore print white.

Basidiospores: (2.75-) 3.0-4.0 (-4.5) x (1.75-) 2.0-2.5 μm, hyaline, ellipsoid, thin-walled, smooth, non amyloid. Basidia: 15.0-21.0 x 4.0-5.5 μm, four-sterigmate, cylindric to slightly clavate, thin-walled, with siderophilous granulation, clamp connection present at basal septum. Cheilo- and Pleurocystidia absent. Pileipellis a hymeniderm of clavate cells, 8-22 x 5-10 μm, with light yellow contents in 4% KOH. Pileus trama of loosely interwoven hyphae, 3-7 μm in diam, thin walled and hyaline to light yellow in 4% KOH, clamp connections present. Caulocystidia: 22-46 x 2-6 μm, cylindric to slightly clavate, hyaline, in clusters, clamp connections present.

Habit: The Alaskan specimens grow on litter, cones and branchlets of *Alnus crispa* and on the moss *Drepanocladus uncinatus* (Hedw.) Warnst., but the specimens from Montana and Idaho were on needles of *Abies grandis* Lindl., *A. lasiocarpa* (Hook.) Nutt., *Picea engelmannii* (Parry) Engelm. and *Pinus contorta* Loud.

Material examined: Alaska (USA): IB 34859, IB 35077, IB 35076, IB 35096, IB 34831, IB 34960, IB 34903, IB 34776 (all in Herbarium Brunner); Montana (USA): OKM 20580 (VPI); Idaho (USA): OKM 2979 (VPI), OKM 2935 (VPI).

Ecology

Calocybe fallax was observed frequently in the two study plots from the 25th of June until the 10th of September 1987 (Fig. 2A). Twelve individual fruitings were observed on one study plot during this time and 16 fruitings observed on the second plot. The fruiting bodies were solitary 43% of the time, 50% of the fruitings were in small groups of not more than five fruiting bodies, and only 7% of the fruitings were in groups of over ten fruiting bodies. Evidence that the fruiting bodies are attached to mycelium in the organic litter indicates that *C. fallax* is probably a decomposer but mycorrhizal synthesis has not been carried

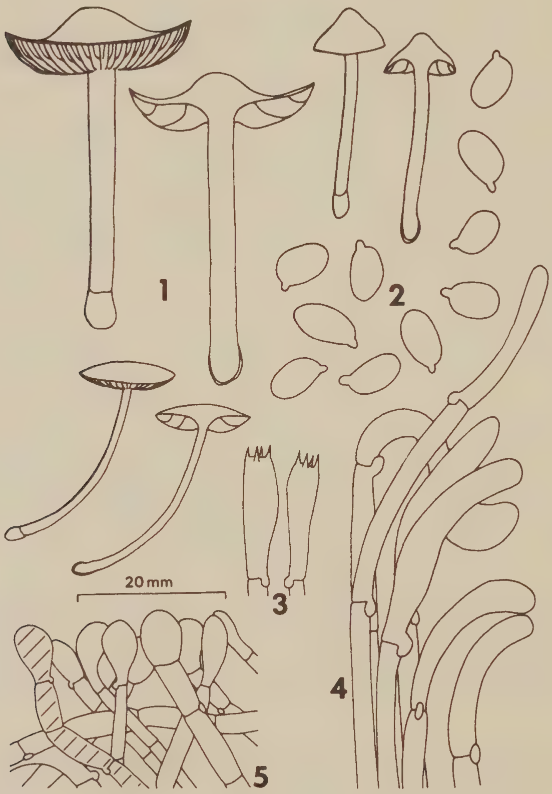


Fig. 1: *Calocybe fallax* (IB 35096): 1. Fruiting bodies (natural size). 2. Spores (x 2000). 3. Basidia (x 1000). 4. Caulocystidia (x 1000). 5. Pileipellis (x 500).

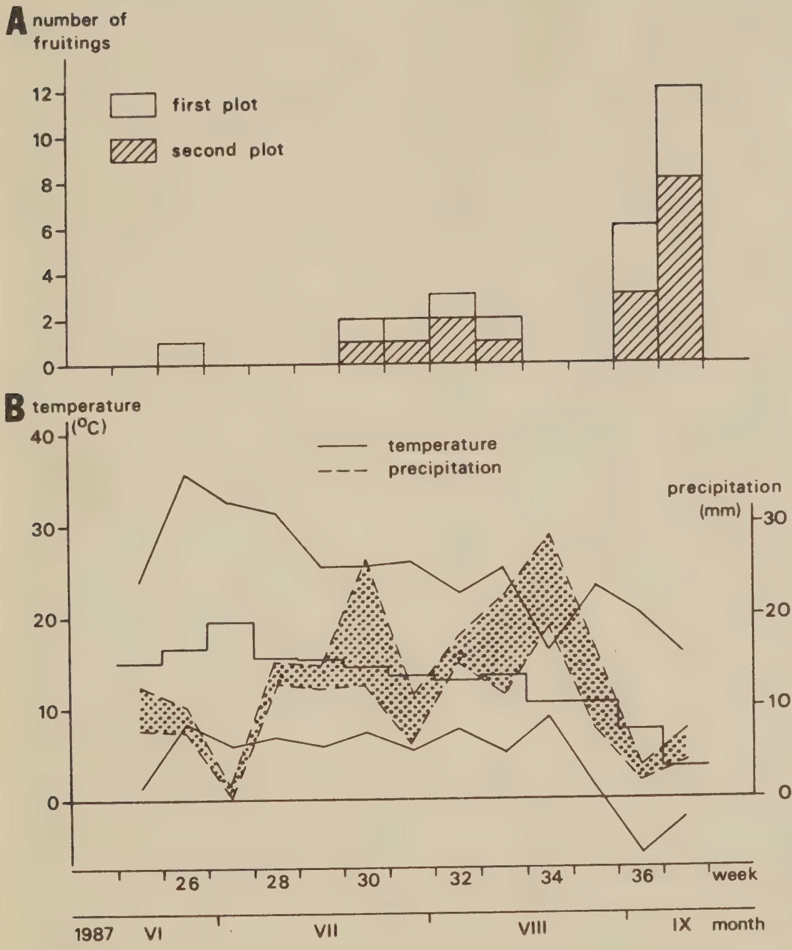


Fig. 2: Fruitings of *Calocybe fallax* and climatic conditions in the *Alnus crispa* stand; data collections weekly from mid of June until mid of September 1987 (25th to 37th week).

A) Total fruitings of *C. fallax* during the 1987 growing season in both study plots (fruitings consist one or more fruiting bodies).

B) Climatic conditions during the 1987 growing season:
temperature: upper line: maximum temperature, middle line: weekly mean temperature, lower line: minimum temperature.

out as yet to illiminate a mycorrhizal role. Fruiting bodies were well dispersed over the two study sites among 26 squares with repetitive fructifications in only 2 squares separated each by a four week interruption.

Major fruitings of 6 and 12 collections occurred on the 3rd and 10th of September 1987 (week 36 and 37, Fig. 2A). These fruitings appeared 2 to 3 weeks after a heavy rainfall on the 16th of August (week 34, 19.1 mm in the alder stand, 29.1 mm in the clearing, Fig. 2B). Simultaneously the minimum temperature in the stand dropped between week 34 and 37 from 9.0 to -2.0°C, and the weekly mean temperature dropped from 10.3 to 3.5°C (Fig. 2B).

Cultural behavior

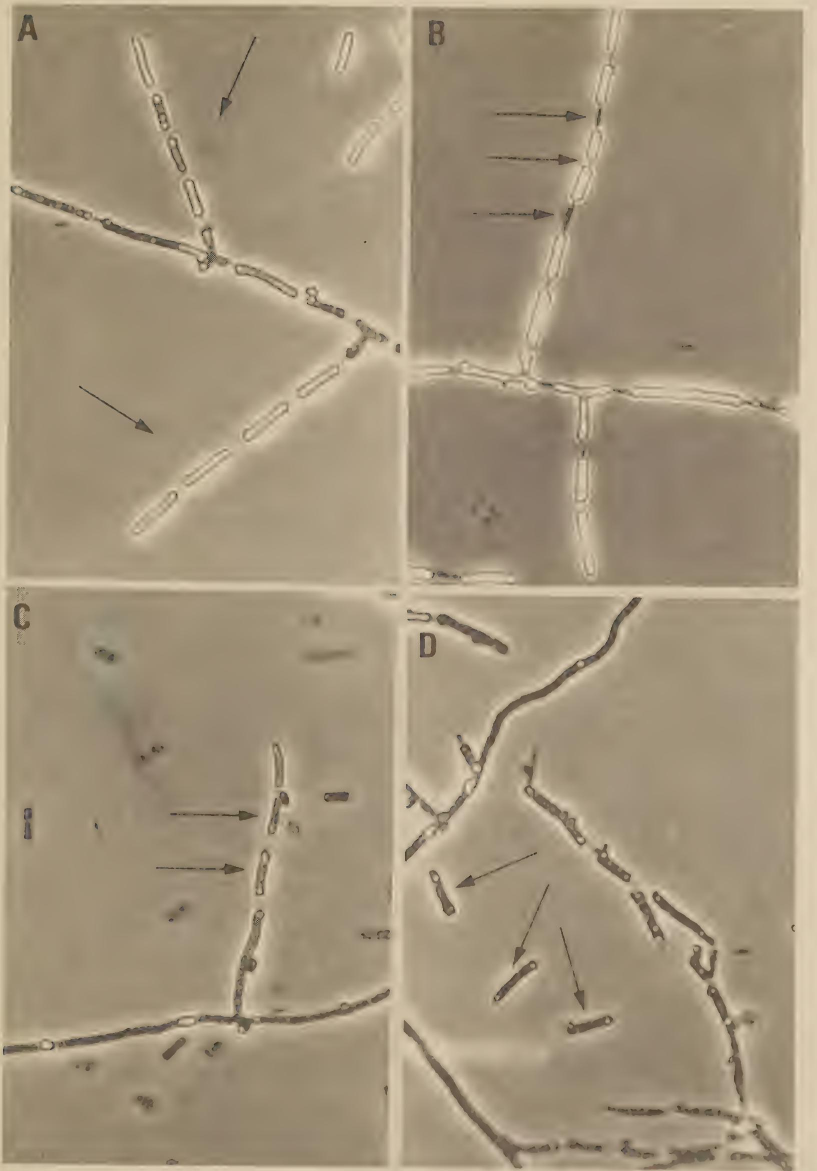
Macroscopic characteristics: Primary mycelial mat white, under U.V. white; one month old cultures on MA loose cottony; aerial mycelium short and dense; growth rate 0.6-0.8 cm in one month at 20°C. Secondary mycelial mat white, under U.V. white; one month old cultures on MA loose cottony; aerial mycelium short and dense; two month old cultures on MA alternating brown and white zones; brown zones appressed on the agar and tough, white zones dense cottony; growth rate on MA 1.0-1.2 cm in one month at 20°C; odor not distinctive.

Microscopic characteristics: Hyphae from primary mycelial mats mostly 30-70+ x 1.5-2.5 μm, unclamped, thin-walled, smooth; in KOH hyaline; uninucleate conidia production similar to binucleate conidia production; uninucleate conidia 4.5-9.0 x 1.5-2.5 μm, hyaline in KOH, without clamp connection; conidia germination within a few days on MA at 20°C with unclamped hyphae. Hyphae from secondary mycelial mats mostly 20-45 x 1.5-3.0 μm, clamped, thin-walled, smooth; in KOH hyaline, some of two month old hyphae irregulary enlarged with scattered light yellow plasmatic pigment, small hyaline incrustations and brown crystals also present. At the apex of morphologically undifferentiated aerial hyphae the binucleate thallic-arthric conidia formed on irregular branches and remain attached forming chains of variable length (Pl. 1A); conidia produced by forming disjunctor cells (Pl. 1B); the clamp connection may or may not be a part of the binucleate conidium (Pl. 1C); binucleate conidia 5-10 x 1.5-3 μm, hyaline in KOH, often with a clamp connection at one end (Pl. 1D); conidia germination within a few days on MA at 20°C with clamped hyphae.

Extracellular oxidase reaction: Syringaldazine and phenol negative; gum guaiac positive after 12 to 15 minutes.

Plate 1: Formation of thallic-arthric conidia from secondary mycelia of *Calocybe fallax* (x 400).

A) Formation of conidia in chains on irregular branches.
B) Empty hyphal segments between differentiating conidia (disjunctor cells).
C) Differentiating conidia with or without a clamp connection.
D) Thallic-arthric conidia.


A
B
C
D

DISCUSSION

Calocybe fallax was first described by Peck as *Agaricus fallax* in 1873 from the USA, but because Peck's name was a later homonym of *Agaricus fallax* Lasch, the name was illegitimate (Redhead & Singer, 1978). Saccardo transferred Peck's *A. fallax* to *Tricholoma* 1887 and it was subsequently recognized as a *Calocybe* by Redhead & Singer (1978). According to Smith (1942), *C. fallax* has been found in several locals across the USA and Canada. It is distributed from Nova Scotia to California between the 35th and the 50st latitudes. Also Pomerleau (1980) mentioned that this species is cosmopolitan and frequently found in Canada and the USA. Smith reported *C. fallax* from both hardwood and conifer forests, Pomerleau only from oak-woods. This infrequently encountered species is new for Alaska and can be expected throughout the northern boreal forest in Canada and the United States.

The fruiting pattern in our study plots clearly showed that fruiting bodies formed following heavy rainfall. In the fall, however, rain came in combination with a dramatic temperature drop and this combination of abiotic factors probably produced the highest fructification rate. No other ecological data on fruiting are reported in the literature.

Anamorphic reproduction of *C. fallax* was only observed in culture, contrary to conidial production on or surrounding the fruiting bodies of *Flagelloscypha abruptiflagellata* Agerer (Agerer, 1975) and *Collybia racemosa* (Pers.:Fr.) Quél. (Watling & Kendrick, 1977). Other reports of conidial production in culture only are with *Crinipellis perniciosa* (Stahel) Singer (Delgado & Cook, 1976), *Marasmius limosus* Quél. (Lamoure, 1960, p. 42) and *Flammulina velutipes* (Curt.:Fr.) Singer (Miller, 1971).

Whereas the conidia in *M. limosus* are produced solely by primary mycelia, in *C. perniciosa* as well as in *F. velutipes*, the conidia are produced only from secondary mycelia. According to Kühner (1977) conidial production by secondary mycelia is much less frequent than by primary mycelia. In addition, he mentioned that primary mycelia produce only uninucleate conidia, but secondary mycelia are able to produce uninucleate conidia as in *F. velutipes* or binucleate conidia as in *Flammula gummosa* (Lasch) Kummer.

C. fallax produces conidia from primary and secondary mycelia. It is rare to encounter conidial production from both primary and secondary mycelia. However, it was reported by Moore (1985) in *Pleurotus cystidiosus* Miller.

The formation of thallic-arthric conidia below follows the scheme devised by Kendrick & Watling (1979, p. 513):

1) The conidia are formed from morphologically undifferentiated vegetative hyphae.

2) The conidia are produced by the the laying down of retraction septa. This leaves an empty hyphal segment between the differentiating conidia (disjunctor cell).

3) The conidia have only been observed in culture and not in nature.

4) The conidia produced by unclamped hyphae are uninucleate, while the conidia produced by clamped hyphae are binucleate. One clamp connection is often a part of the binucleate conidium.

The typical development pattern of conidia produced by white-spored agarics examined so far, has been simply formed and released by the splitting apart of a double walled septum between each conidium (Kendrick & Watling, 1979). With the discovery of the production of retraction septa in conidium formation for *Calocybe fallax*, it appears one cannot state that different conidial ontogenies are associated with white- or dark-spored agarics respectively as conjectured by Kühner (1977) and Watling (in Kendrick & Watling, 1979).

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MYCOTAXON

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PARVACOCCUM PINI GEN. ET SP. NOV. (RHYTISMATACEAE) ON WESTERN WHITE PINE

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ABSTRACT

Parvacoccum pini gen. et sp. nov. (Rhytismataceae) was found on the bark of shoots of a rust killed western white pine (Pinus monticola Dougl.) in south coastal British Columbia, Canada. It possesses unique appendaged ascospores, but in many characteristics it was similar to several Coccomyces spp. which inhabit conifer branches. Cultures were obtained from ascospores.

INTRODUCTION

During a survey of an old, clonal western white pine (Pinus monticola Dougl.) plantation established for resistance to blister rust (Cronartium ribicola J.C. Fisch. ex. Rab.) (Hunt and Meagher 1988), a number of instances were found where branches had arisen from the root stock. Many of these shoots were dead from blister rust, and on the distal tips of one was a unique phacidiaceous fungus. A search was made for this fungus throughout the plantation and some native stands of western white pine, but no further specimens were found. After comparison with apparently related species, it became obvious that a new genus in the Rhytismataceae was necessary to accommodate it.

DESCRIPTION

Parvacoccum gen. nov. Fig. 1-5

Etym: from Latin parva, small and Cocos, the genus for coconut, referring to the appearance of the ascostromata as small coconuts.

Genus Coccomyces de Notaris similis, sed ascosporae appendiculatae, muco obscura involutae et non-clavatae.

Species typica: Parvacoccum pini sp. nov.

Parvacoccum pini sp. nov.

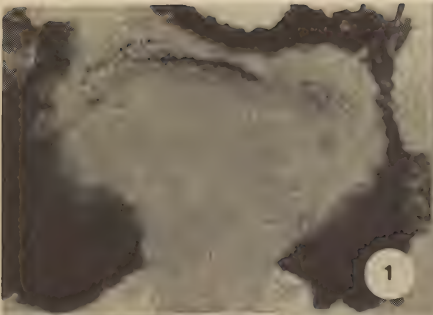
Ascostromata erumpentia, sessilia, solitaria, gregaria, orbicularia, atra, 0.6 - 1.0 mm. diam; excipulo atro, crustoso, pseudoparenchae, cellulae 3-5 µm diam. et amorphae materiae irregularia dehiscentia; hymenio luteolus; subhymenio luteolus, circa 60 mm crassa pseudoparenchae, cellulae 3-5 µm diam. Asci clavati, unitunicati, J-, 4-8-spori, apices circumscissilis, 71-116 x 4-6.5 µm. Ascosporae fusiformae, hyalinae, non-septatae, ambabus apices infundibuliformis appendiculatis, muco obscuris involutis, 16-18 x 2µm. Paraphyses filiformes, non-septatis, recti, nonnunquam ad apicem leniter inflati, 130 x 0.7-1.5 µm. Anamorphosum absunt.

Typus: in ramuscidis Pini monticolae Dougl. ab Cronarti ribicola

DAVFP 23420.

Ascostromata erumpent, sessile, solitary, gregarious, orbicular, black, 0.6 - 1.0 mm diam; excipulum black, crustose, opening by an irregular longitudinal split to expose the light yellow hymenium, composed of pseudoparenchyma and dark amorphous material, cells 3-5 µm diam., approx 40 µm thick at the base; subhymenium pale yellow, approx 60 µm thick, cells 3-5 µm diam.

Figs. 1 -5: Parvacoccum pini 1. Apothecium, median section. x 100. 2. Hymenium showing asci and paraphyses. x 450. 3. Fusiform ascopores with funnel-shaped appendages and obscure gelatinous appendages. x 450. 4. Malt agar culture, 1 month old. x 6.3. 5. Apothecia, habit on pine twig. Note irregular longitudinal opening. x 16.



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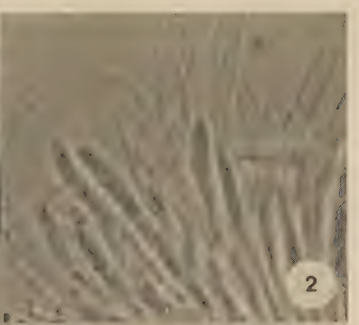

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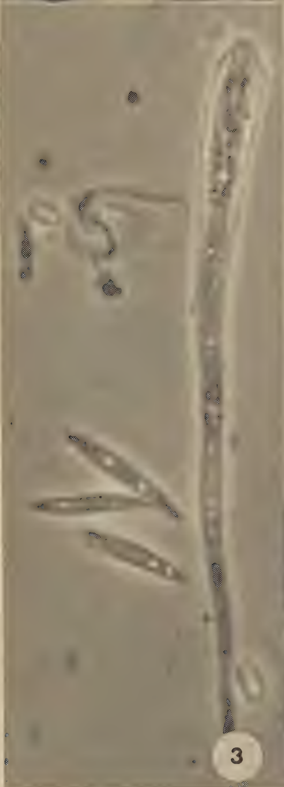

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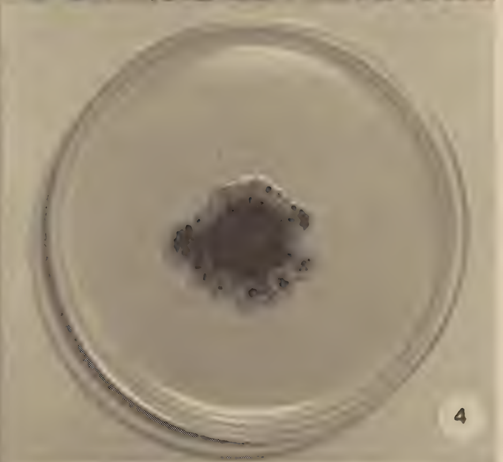

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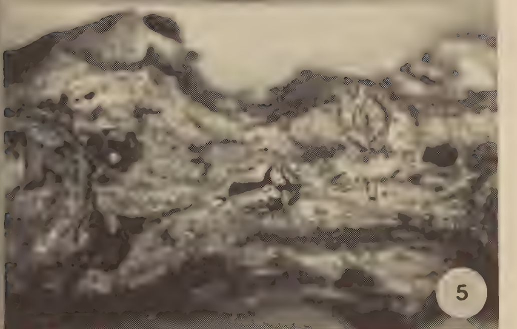

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Asci long-stalked, clavate, unitunicate, thin-walled, J-, 4-8-spored, with a circular apical pore, 71-116 x 4-6.5 µm. Ascospores symmetrical, fusiform, hyaline, non-septate, with a funnel-shaped appendage at both ends, straight, gelatinous sheath obscure, 16-18 x 2 µm. Paraphyses filiform, non-septate, straight, sometimes slightly swollen at the tips, 130 x 0.7-1.5 µm. Anamorph unknown. Holotype: DAVFP 23420 in blister rust killed branches of *Pinus monticola* Dougl. near Mesachie Lake, B.C., Canada.
Coll. R.S. Hunt, June 20, 1986

Specimen: Mesachie Lake, B.C. 13.v. 1986. DAVFP 23419.

Cultural Studies

Ascospores of *P. pini* germinated readily on malt agar. Colonies were slow growing, compact, dark brown; the surface was slightly woolly, reverse brown with a very slight, yellowish diffusion zone in the agar. The mycelium was generally of two types: a) submerged hyphae almost hyaline, very narrow (1-1.5 µm) densely interwoven; or b) surface hyphae brown, wide (4µm), growing more or less parallel (ropy). No fruiting was observed; however, dark, immersed, dense stroma-like structures, 0.5-1.0 mm diameter, formed in the agar.

When cultures were incubated at 5, 10, 15, 20 or 25°C, little growth occurred at 5°C. Optimum growth occurred at 20°C. Even then, less than one-half the diameter of a 9-cm petri plate was covered in 3 months.

DISCUSSION

The thin-walled, J^- asci with rounded tips, sheathed hyalined ascospores and the stromatic morphology place *Parvacoccum* in the family Rhytismataceae (Sherwood 1980; DiCosmo *et al*. 1984; Cannon and Minter 1986). The apothecial shape, stromatic structure, and hymenium with clavate asci and aseptate filiform paraphyses are characteristics of *Coccomyces* de Not. (Sherwood 1980). Moreover, the association with recently killed pine branches and the apothecium splitting open irregularly to expose a prominent yellowish hymenium may suggest a close relationship to other *Coccomyces* spp. on conifers (*C. heterophyllae* Funk, *C. mertensianae* Sherw., *C. strobi* Reid and Cain, and *C. papillatus* Sherw.) that have a similar habitat and structure (Sherwood 1980; Sherwood-Pike 1985). However, unique spore characteristics are used to delineate some Rhytismataceae genera (Darker 1967; Cannon and Minter 1986). Here the ascospores are not typically fusiform-clavate as in Coccomyces, but are symmetrically fusiform with appendages. The funnel-shaped appendages somewhat resemble the conidial appendages of Apostrasseria (Nag Raj 1983) and of other anamorph genera of Phacidiaceae (DiCosmo et al. 1984). We are unaware of any such appendages in any other anamorph or teleomorph genera in the Rhytismataceae. Also, Coccomyces asci lack an obvious apical pore and the spores are usually conspicuously sheathed (Sherwood 1980); whereas, Parvacoccum possesses both an obscure ascus pore and obscure ascospore sheath. Parvacoccum may be closely related to some Coccomyces spp., but it is clearly a unique genus.

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ETUDE MICROSCOPIQUE DE SPECIMENS TYPES DE RUSSULES TROPICALES DE LA SOUS-SECTION DIVERSICOLORES

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RESUME

La sous-section Diversicolores, placé par Singer parmi les Pelliculariae Heim est étudiée et discutée. Les caractères microscopiques de *R. venezueliana* Singer, *R. verna* Singer et *R. diversicolor* Pegler sont décrits et illustrés en détail.

SUMMARY

The subsection Diversicolores, placed by Singer in the Pellicularia Heim is studied and discussed. Microscopical features of the types of *R. venezueliana* Singer, *R. verna* Singer and *R. diversicolor* Pegler are extensively described and illustrated.

Etude microscopique des types

Tous les exsiccata ont été traités par une solution aqueuse (ca. 20%) de KOH pour faciliter la dissociation et le regonflement des tissus, dont l'étude s'est effectuée à partir de préparations semi-permanentes dans le rouge Congo ammonical additionné de 10% de glycérine. Dans les descriptions qui suivent, les dimensions sporales, basées sur vingt spores, donnent la longueur et la largeur moyennes, accompagnées de leur écart type (standard deviation): suit encore, entre parenthèses, le rapport moyen de la longueur sur la largeur.

Singer reconnaît trois espèces dans cette sous-section, qu'il situe dans la section *Pellicularíae* Heim, à savoir : *R. diversicolor* Singer (de la Martinique), *R. venezueliana* Singer (du Venezuela) et *R. verna* Singer (du Brésil). Après examen des caractères microscopiques des trois spécimens-types, il nous est apparu clairement qu'il s'agissait d'un groupement hétérogène, qui devra probablement être scindé.

Nous donnons d'abord le résultat de notre examen de l'espèce type de la sous-section et des deux autres espèces que Singer (1983)) met dans les *Diversicolores* :

RUSSULA DIVERSICOLOR Pegler in Pegler & Singer, Mycotaxon 12 : 94 (1980)

Caractères microscopiques - Fig. 1-3

Spores brièvement ellipsoïdes, 9,09 ± 1,49 x 8,19 ± 1,35 µm (Q = 1,11), fortement échinulées à échinulées-verruqueuses, à verrues coniques ou hémisphériques, atteignant 1 parfois même 1,5 µm, obtuses ou assez aiguës, nombreuses, nettement, mais souvent partiellement, amyloïdes, très localement zébrées-réticulées, à connexifs

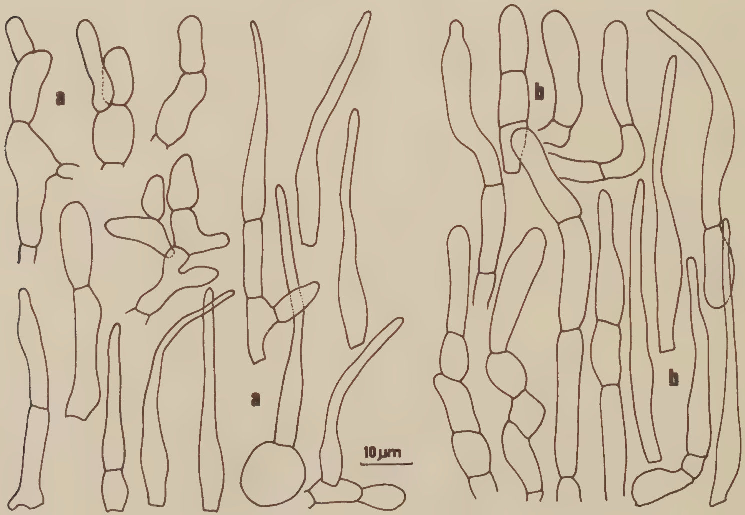

Fig. 1 : *R. diversicolor*. a : Eléments terminaux du revêtement piléique; b : éléments terminaux du revêtement du stipe.

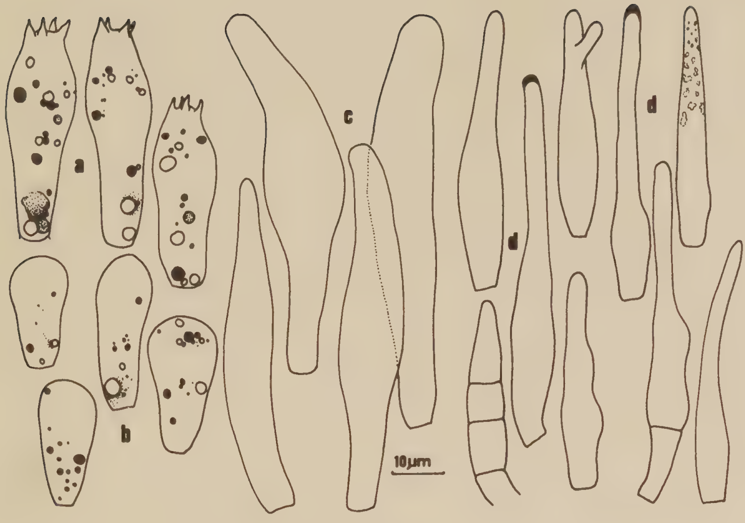

Fig. 2 : *R. diversicolor*. a-b : Basides et basidioles avec représentation de leur contenu; c : poils cystidiformes des faces, caractérisés par l'absence de tout continu; d : poils cystidiformes de l'arête avec indication des incrustations occasionelles de la paroi (en pointillé) et du contenu jaunâtre réfringent, peu abondant, concentré au sommet de la cellule (en noir).

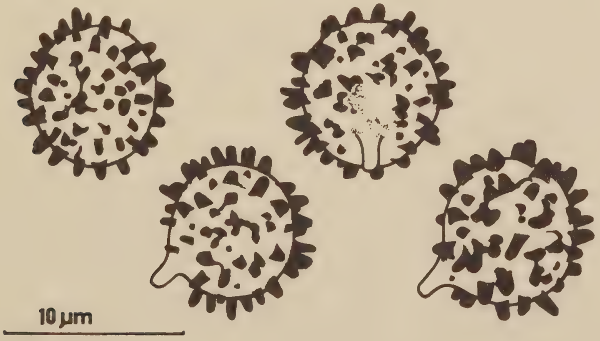

Fig. 3 : *R. diversicolor*. Ornementation sporale, observée dans le réactif de Melzer.

courts et très fins; plage non ou parfois très légèrement amyloïde, irrégulière. **Basides** 35-45 x 12,5-14(-15) µm, tétrasporiques, subclavées à longuement lancéolées, ne contenant que quelques globules réfringts de dimensions variables; stérigmates 2,5-3,5 µm de long, aigus; basidioles assez trapues, volumineuses, clavées. Macrocystides à contenu typique, absentes. **Poils cystidiformes** de l'arête de dimensions variables, 6-8(-10) µm diam., s'amincissant jusqu'à 2,5-3,5 µm vers le sommet, de longueur variable mais n'excédant guère 60 µm de long, lancéolés, subfusiformes à subulés; contenu réduit, concentré au sommet, réfringent; paroi mince, parfois discrètement incrustée de petites plaques hyalines. Cystides faciales 65-80 x 10 -13(-18) µm, émergentes d'env. 25 µm, subfusiformes à longuement lancéolées, obtuses, à paroi mince. **Revêtement** piléique formé d'hypes grêles, emmêlées, 2-6 µm diam., gélifiées, émettant un suprapellis lâche de poils parfois fortement ramifiés, composés d'articles courts, elliptiques, ampullacés ou de forme plus irrégulière; l'article terminal souvent rétréci ou graduellement aminci vers le sommet, parfois jusqu'à 60 µm de long, subulé et naissant le plus souvent d'un article basal fortement renflé, même sphérique. **Revêtement du stipe** formé d'hyphes emmêlées, peu gélifiées, 3-6 µm diam., à paroi mince, émettant un suprapellis discontinu, semblable à celui du chapeau, c.-à-d. composé de poils grêles, peu ramifiés, subulés, 30-60 x 4-6 µm, s'amincissant jusqu'à 1,5-2,5 µm au sommet, et d'éléments également peu ramifiés, mais fortement cloisonnés, à articles courts, cylindracés, elliptiques, obtus et parfois un peu rétrécis au sommet. Dermatocystides absentes. Hyphes oléifères très rares.

Martinique, Anse à Voile, octobre 1975, en forêt mésophile, Fiard 628/A (K).

RUSSULA VENEZUELIANA Singer, Kew Bull. 1952 : 295 (1952).

Caractères microscopiques - Fig. 4-6.

Spores obovales, parfois même légèrement réniformes, 7,77 ± 1,65 x 6,50 ± 1,21 µm (Q = 1,19), fortement échinulées, subréticulées-connexées, à connexifs très délicats, avec quelques mailles complètes; verrues nombreuses, coniques à cylindracées, atteignant 1,5(2) µm de haut, obtuses à assez aiguës, nettement amyloïdes; plage non ou très faiblement amyloïde. **Basides** (32-) 35 - 40(-43) x (9-)10 - 11 µm, tétrasporiques, clavées, optiquement vides sauf parfois pour quelques inclusions cristalines; basidioles assez allongées, clavées; stérigmates robustes et rigides, 6 - 7 x 2 - 2,5 µm. **Cystides** assez rares, 55 - 80 x 7,5 - 8,5 µm, cylindracées à subfusiformes, à sommet obtus ou appendiculé, optiquement vides mais souvent avec quelques plaques ou granulations réfringentes sur la face interne de la paroi; celle-ci mince. **Poils cystidiformes** occupant l'arête entière, 20 - 35 x (3-)5 - 6(-8) µm, très grêles et versiformes, souvent sinueux, à sommet obtus, parfois légèrement renflé - capité, à paroi mince; contenu un peu réfringent. **Revêtement piléique gélifié**, composé d'hyphes couchées, emmêlées, 3 - 6 µm diam., émettant un suprapellis discontinu de longs poils ramifiés, fortement cloisonnées, à articles courts, cylindracés, elliptiques, rarement un peu renflés, à contenu finement granuleux; article terminal légèrement rétréci dans sa partie distale ou graduellement aminci vers un sommet obtus, rarement mucroné. Dans le suprapellis s'observent également de longs articles terminaux, filamenteux, mais cystidiformes par leur contenu, excédant souvent 100 µm (le plus souvent 40-150 µm), avec des plaques et granules réfringents sur la face interne de la paroi. **Revêtement du stipe** formé d'hyphes emmêlées, 3 - 6 µm diam., optiquement vides ou à contenu très finement granuleux, émettant un suprapellis de poils fortement cloisonnés, localement réunis en touffes; articles courtement cylindracés, jusqu'à 10(-15) µm de long; article terminal le plus souvent 10 - 20(-30) µm de long, obtus, sinueux, le plus souvent rétréci dans sa portion distale. Dermatocystides abondantes, surtout vers la base du stipe, (17-)25 - 40(-60) x (4-)5 x 6,5 µm, généralement constituant l'article terminal des poils, lagéniformes, subulées à coniques, mucronées - capitées, rarement obtuses, à contenu réduit, réfringent-granuleux; articles filamenteux, cystidiformes également présents, mais plus courts que dans le chapeau. Hyphes oléifères rares. **Mycélium** basal formé d'hyphes de 2 - 4 µm diam., rarement avec quelques articles renflés, souvent ramifiés - anastomosés près des cloisons; article terminal à contenu incolore, finement granuleux et à paroi sensiblement plus mince. Dermatocystides typiques dans le mycélium non observées.

Venezuela, Caracas, Rio Chaciato, sur le sol en forêt sèche, novembre 1949, Dennis 408 (K).

RUSSULA VERNA Singer, Beihefte Nova Hedw. 77 : 217-219 (1983).

Caractères microscopiques - Fig. 7,8.

Spores brièvement ellipsoïdes, 6,7 ± 1,41 x 5,00 ± 1,24 µm (Q = 1,22), verruqueuses, piquétées, à verrues assez peu serrées, obtuses, très petites à assez grosses, atteignant 1 µm; plage non amyloïde, plutôt arrondie, verruculeuse au bord; **Basides** 30 - 40 x (8-)9 - 11 µm, peu volumineuses, tétrasporiques, légèrement clavées; basidioles allongées, clavées; stérigmates 3 - 5 µm de long, aigus. **Poils cystidiformes** de l'arête très nombreux, exceptionellement excédant les dimensions des basides, versiformes, assez souvent fusiformes à fusiformes-ventrus, obtus à longuement

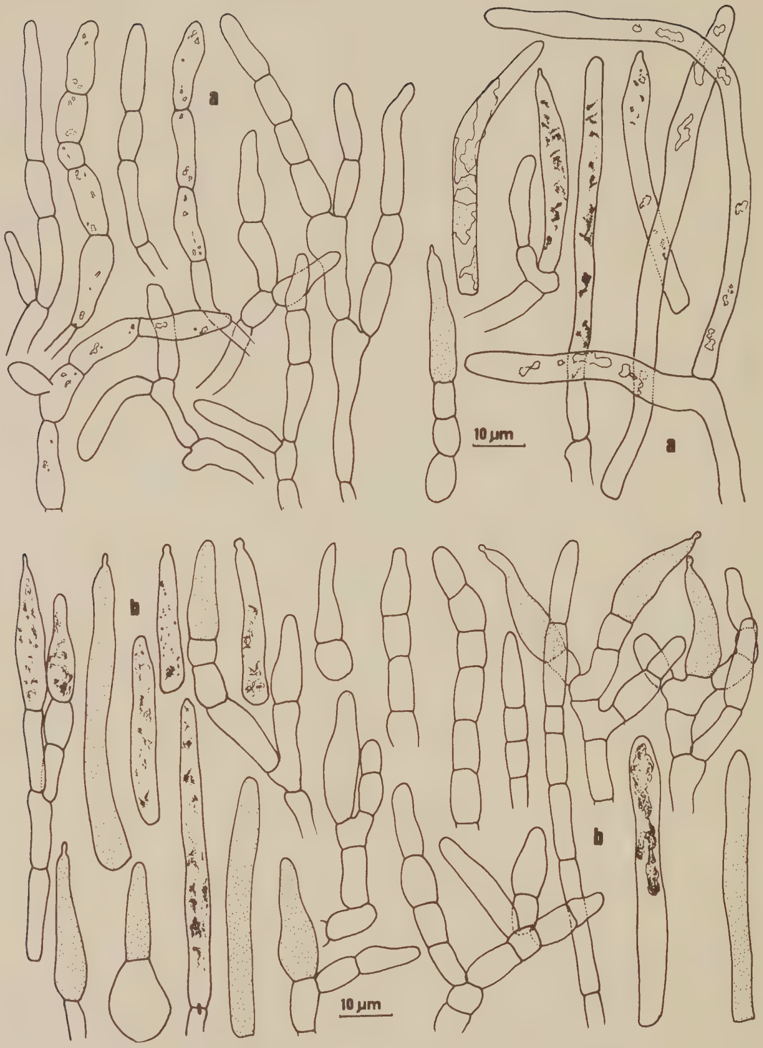

Fig. 4 : *R. venezueliana.* a : revêtement piléique avec, à gauche, éléments terminaux des poils (le contenu finement granulé n'est pas toujours indiqué) et, à droite, les extrémités cystidiformes, montrant le contenu granuleux-réfringent; b : revêtement du stipe montrant les articles terminaux des poils (sans indication du contenu) et les extrémités cystidiformes (à contenu parfois schématisé ou pointillé).

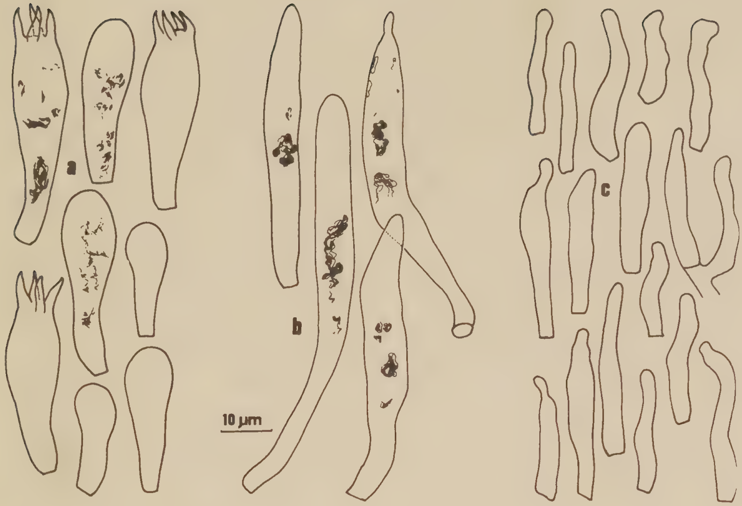

Fig. 5 : *R. venezueliana.* a : Basides et basidioles montrant le contenu parfois finement granuleux; b : cystides faciales; c : poils occupant l'arête de lamelles.

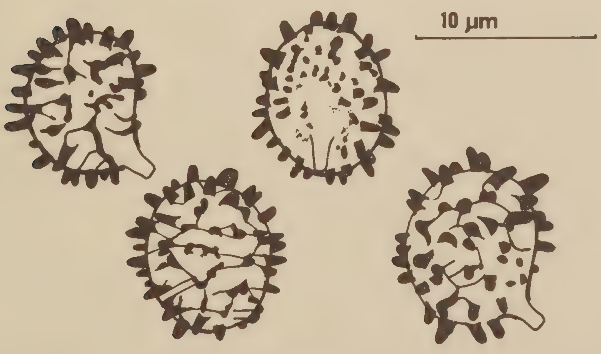

Fig. 6 : *R. venezueliana.* Ornementation sporale, observée dans le réactif de Melzer.

appendiculés au sommet, parfois presque aciculaires, à paroi mince; ici et là on observe des poils clavés à paroi légèrement épaissie. **Cystides** faciales abondantes, aussi parmi les poils de l'arête, 57 - 70(-80) x (8-)10 - 12 µm, légèrement brunâtres, fusiformes, appendiculées - mucronées au sommet, à paroi mince, ne contenant que quelques inclusions amorphes, parfois réfringentes. **Revêtement piléique** composé d'hyphes couchées, emmêlées, 2 - 6 µm diam., écartées par une forte gélification, émettant un suprapellis discontinu de poils ramifiés, localement enchevêtrés, grêles, zébrés à l'intérieur par un nécropigment jaunâtre, composés d'articles cylindracés, plutôt courts; article terminal plus ou moins cylindracé ou atténué au sommet, celui-ci obtus, très souvent capité et à contenu réfringent. Dispersé dans le suprapellis, s'observent aussi des éléments très longs, filamenteux, 4 µm diam., caractérisés par un contenu légèrement granuleux, réfringent. **Revêtement du stipe** formé d'une couche assez mince, à gélification moindre que dans le revêtement piléique, composé d'hyphes de 2,5 - 5 µm diam., emmêlées, émettant un suprapellis d'articles légèrement plus larges, également emmêlés, couchés, lâchement ramifiés, s'amincissant légèrement au sommet, celui-ci obtus, parfois plus ou moins capité. Dispersé dans ce suprapellis on retrouve comme dans le revêtement piléique des hyphes cylindracées, dont le contenu se montre légèrement réfringent, même granuleux - guttulé par endroit. Dans la moitié supérieure du stipe, on observe des poils dressés, isolés ou groupés en touffes, analoques aux poils cystidiformes dans l'arête. Dermatocystides bien différenciées absentes. Hyphes oléifères présentes.

Brésil, Amazonas, 30 km N de Manaus, juin 1977, leg. T. St. John, Singer B9918 (INPA).

OBSERVATIONS

On peut conclure des descriptions ci-dessus et des dessins les accompagnant, qu'il s'agit certainement de trois espèces bien distinctes. Les différences sont en effet beaucoup plus grandes que ne le laissaient supposer les descriptions et commentaires de Singer, qui a fondé la sous-section des *Diversicolores* sur l'absence de dermatocystides et l'ornementation sporale formée de verrues isolées ou partiellement reliées.

Il existe aussi des différences importantes dans la composition des revêtements. Il n'y a en effet que le seule *R. diversicolor* qui soit dépourvu de tout élément cystidiomorphe. Singer (1983) parle cependant, aussi chez cette dernière, de dermatocystides ciliées, comme chez *R. vesca*. Ces structures, étant optiquement vides, sont pour nous de simples poils; chez *R. venezueliana* et *R. verna* ces poils sont d'ailleurs beaucoup moins évidents. Ces

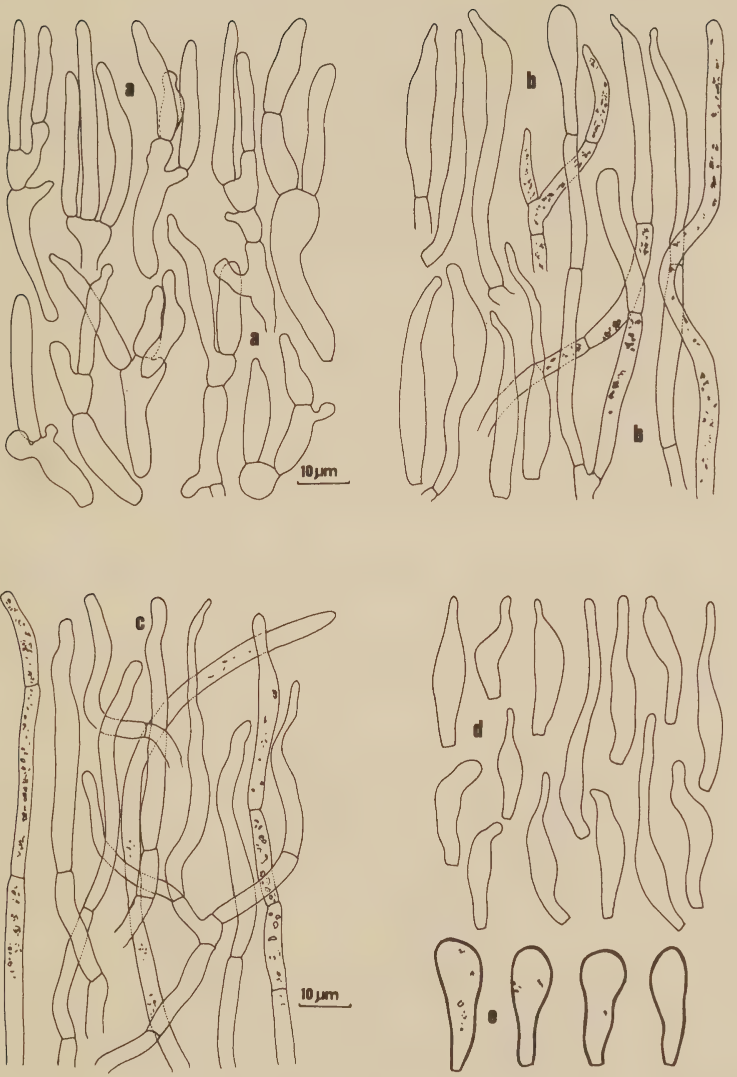

Fig. 7 : *R. verna.* a : poils ramifiés formant le chevelu du revêtement piléique; b-c : revêtement du stipe, éléments terminaux de la moitié supérieure (b) et vers la base (c) du stipe (remarque le contenu finement granulé cystidiomorphe de certains éléments); d-e: éléments occupant l'arête des lamelles.

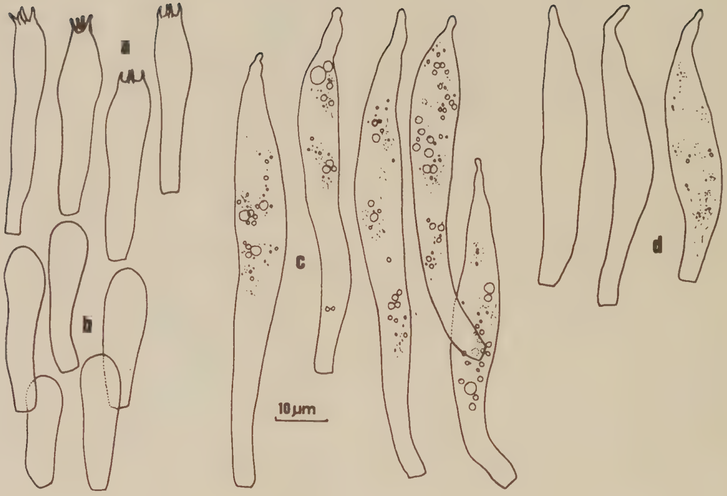

Fig. 8 : *R. verna.* a : basides; b : basidioles; c-d : cystides faciales (c) et près de l'arête (d) avec indication de leur contenu.

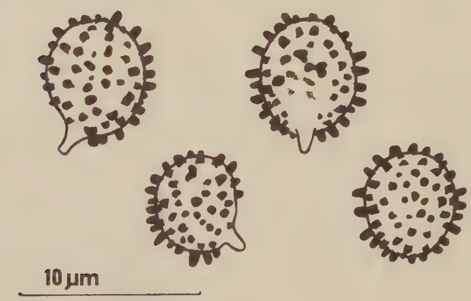

Fig. 9 : *R. verna.* Ornementation sporale, observée dans le réactif de Melzer.

deux dernières possèdent, dans les revêtements, des filaments à contenu granuleux-réfringent, tandis que *R. venezueliana* possède en plus, chez une partie des poils, des articles terminaux différenciés non seulement par leur forme mais aussi par leur contenu granuleux-réfringent, comme on rencontre fréquemment dans les *Pelliculariae* Heim (observation personnelle). Bien qu'elles n'aient pas de vraies dermatocystides à contenu typique, noircissant aux réactifs sulfoaldéhydiques, *R. venezueliana* et *R. verna* possèdent donc des élements dont on peut difficilement nier le caractère cystidomorphe. Enfin, leurs cystides hyméniennes naissent plus profondément et ne sont pas optiquement vides, comme chez *R. diversicolor*.

Nous comparons ci-après les données de la littérature et les nôtres :

R. DIVERSICOLOR

	Pegler (1980,1986)	Singer (1983)	nos mesures
spores	8,8±0,4 x 7,6±0,4 µm	10,2 x 7,5-9,5 µm	9,09±1,49 x 8,19±1,35 µm
basides	33-40 x 11-13 µm	(24-)32-36(-46) x 11-11,8 µm	35-45 x 12,5-14(-15) µm
Cystides des faces	absentes	38-63 x 12-13,5 µm	65-80 x 10-13(-18) µm
poils de l'arête	55-80 x 6-11 µm	(20)40-55(-62) µm de long 6-10 µm de large à la base 2,5-3(-6) µm au sommet	jusqu'à 60 µm de long 6-8(-10) µm à la base 2,5-3,5 µm au sommet

Bien que Pegler ait étudié plusieurs spécimens en 1986, il cite les mêmes dimensions qu'en 1980. Ce qui frappe le plus dans sa description est le fait qu'il n'a pas remarqué les "cystides" faciales, émergeant pourtant d'environ 25 µm ! En comparant les dimensions des basides, il faut noter aussi que les données de Singer pour la largeur, basées probablement sur petit nombre de mesures, sont trop basses.

Les deux dernières espèces ne sont connues que du type. Notre comparaison montre bien que les descriptions de Singer sont, dans ce cas-ci, peu précises quant aux dimensions des structures microscopiques, même les plus importantes comme celles des spores (Singer ne dit pas si les ornements sont incluse dans les mesures) Il en résulte qu'il est impossible de se faire une idée de l'espèce si on n'a pas vu le matériel en question, d'autant plus que les illustrations, accompagnant parfois les descriptions de Singer, sont approximatives parce que trop schématisées.

R. VENEZUELIANA

	Singer (1952,1983)	nos mesures
spores	9,5-9,7 x 8-8,3 µm	7,77 ±1,65 x 6,50 ±1,21 µm
basides	43-51 x 11-13,8 µm -13(1983)	(32-)35-40(-43) x (9-)10-11 µm
Cystides faciales	pas de dimensions	55-80 x 7,5-8,5 µm
poils de l'arête	non observés ?	20-35 x (3-)5-6(-8) µm

R. VERNA

	Singer (1983)	nos mesures
spores	6,8-8,5 x 6-6,5 µm	6,07 ±1,41 x 5,00 ±1,24 µm
basides	pas de dimensions	30-40 x (8-)-11 µm
Cystides faciales	50-57 x 7,5-13 µm	57-70(-80) x (8-)10-12 µm
poils de l'arête	non observés ?	excédant exceptionellement les dimensions des basides

CONCLUSION

Les affinités de ces trois espèces avec les autres groupes de Russules restent encore assez obscures, sauf pour *R. diversicolor*, qui appartient certainement aux *Heterophyllae*, comme l'a observé Pegler (1986 : 627). La plage non amyloïde, la sporée crème, l'absence de macrocystides typiques, les poils subulés de l'arête et des revêtements indiquent une relation étroite avec les *Amoeninae* Singer, parmi lesquelles cette espèce devrait probablement être située.

Trois espèces pelliculaires, récemment décrites du Zaïre (Buyck, l.c.) ainsi que *R. incrassata* ad int. et *R. annulatobadia* Beeli appartiennent également aux *Amoeninae*. La présence d'un anneau chez nombre d'espèces tropicales (dans ce cas-ci *R. fimbriata* Buyck et *R. annulatobadia* Beeli n'a probablement importance qu'au niveau de l'espèce. En effet, l'anneau peut être considéré comme une adaptation spécifique au climat, comme l'est d'ailleur la fragilité de la chair dans certaines espèces tropicales. Selon Heim (1938 : 173), "La particularité de l'anneau n'est pas stable; elle varie quantitativement à l'intérieur de l'espèce et elle est même dans une mesure *individuelle.* Ayant personnellement examiné un grand nombre de Russules tropicales, j'ai des doutes à ce sujet : la présence ou l'absence de l'anneau m'a - au contraire - semblé être une caractéristique constante de l'espèce. Cependant, un anneau est souvent fugace et n'est parfois présent que dans les stades très jeunes. Un example nous est fourni par Beeli (1928), qui a décrit un carpophore non-annelé (anneau fugace !) de *R. annulatobadia* comme *R. badia* Beeli (non Quélet !) qui peut donc être considérée synonyme de *R. annulatobadia* Beeli.

Clé des espèces tropicales appartenant aux *Amoeninae* s.l.

1. Chapeau plutôt rouge : revêtement du stipe formé de poils à paroi épaisse (Afrique).
   R. annulatobadia Beeli
1. Chapeau plutôt jaune, vert ou brun; revêtement du stipe formé de poils à paroi mince :

    2. Longueur des poils cystidiformes de l'arête n'excédant qu'exceptionnellement 60 µm :

        3. Revêtement pilétique à poils remarquablement plus volumineux que les hyphes du subpellis. Spores à ornementation subréticulé à réticulée (Afrique).
           R. pausiaca Buyck

        3. Revêtement piléique à poils non remarquablement plus larges que les hyphes du subpellis. Spores à verrues isolées ou à rares connexifs (Amérique du Sud).
           R. diversicolor Pegler

    2. La majorité des poils cystidiformes de l'arête excédant 60 µm de long :

        4. Espèce non annelée à chapeau vert et jaune; spores à ornementation très basse, subréticulée à réticulée (Afrique).
           R. ciliata Buyck
        4. Chapeau brunâtre :

            5. Espèce annelée à chapeau mat, craquelé; poils des revêtements à paroi mince (Afrique).
               R. fimbriata Buyck

5. Espèce dépourvue d'anneau, à chapeau brillant; une partie des poils du revêtement à paroi épaisse (Afrique).
R. incrassata Buyck ad int.

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RESUME

La sous-section *Pluviales*, placé par Singer parmi les Pelliculariae Heim, est étudiée et discutée. Les caractères microscopiques de *R. pluvialis* Singer et de *R. leguminosarum* Singer sont décrits en détail et illustrés.

SUMMARY

The sub-section *Pluviales*, placed by Singer in the Pelliculariae Heim, is studied and discussed. Microscopical features of the types of *R. pluvialis* Singer and of *R. leguminosarum* Singer are extensively described and illustrated.

ETUDE MICROSCOPIQUE DES TYPES

Tous les exsiccata ont été traités par une solution aqueuse (ca. 20% de) KOH pour faciliter la dissociation et le regonflement des tissus, dont l'étude s'est effectuée à partir de préparations semi-permanentes dans le rouge Congó ammonical additionné de 10% de glycérine. Dans les descriptions qui suivent, les dimensions sporales, basées sur vingt spores, donnent la longueur et la largeur moyennes, accompagnées de leur écart-type (standard deviation); suit encore, entre parenthèses, le rapport moyen de la longueur sur la largeur.

Singer reconnaît deux espèces dans cette sous-section, qu'il situe dans la section *Pelliculariae* Heim, à savoir : *R. pluvialis* Singer et *R. leguminosarum* Singer, toutes deux du Brésil. La sous-section *Pluviales* est caractérisée par des pigments lilacins, pourpres ou violacés abondants, la présence de macrocystides, l'odeur nulle et la saveur douce.

Nous donnons d'abord le résultat de notre examen des spécimens-types :

RUSSULA PLUVIALIS Singer, Beihefte Nova Hedw. 77 : 221-227 (1983).

Caractères microscopiques - Fig. 1 - 3.

Spores ellipsoïdes à nettement oblongues, 7,01 ± 1,62 x 5,82 ± 1,60 µm (Q = 1,21), verruqueuses, à verrues isolées, hémisphériques à courtement cylindracées, obtuses, relativement espacées, atteignant 1 µm de haut, nettement amyloïdes; plage peu nette, non amyloïde, verruculeuse. **Basides** 30-40 x (8-)9-10 µm, assez allongées, tétrasporiques, légèrement clavées, généralement optiquement vides; stérigmates petits, 4-5 x 1-2 µm, aigus; basidioles allongées, clavées, souvent à contour un peu irrégulier ou sinueux en coupe optique. **Poils cystidiformes** de l'arête très nombreux, généralement 20-30 x 4-8 µm, assez souvent fusiformes - ventrus, lancéolés, obtus, à paroi mince, optiquement vides. **Cystides** assez abondantes, 40-80(-120) x 8-12(-15) um, les plus petites près de l'arête, clavées, subcylindracées, subfusiformes, obtuses ou mucronées au sommet, à paroi mince; contenu à paillettes réfringentes. **Revêtement piléique** composé d'hyphes emmêlées, 2-4 µm diam., peu gélifiées, quelques-unes avec des zébrures transversales, celles-ci nettement métachromatiques au bleu de crésyl; suprapellis dense de poils plus ou moins dressés au centre du chapeau, formés d'articles cylindracés à ellipsoïdes, 3-10 µm diam., à paroi mince et métachromatique au bleu de crésyl, naissant le plus souvent par plusieurs d'une même cellule basale, celle-ci plus volumineuse, subglobuleuse, jusqu'à 18 µm diam.; l'article terminal plus long, généralement 15-40(-60) µm de long, la géniforme, conique ou graduellement atténué vers le sommet, parfois même cylindracé, obtus, à contenu légèrement réfringent. Dermatocystides très abondantes, à paroi également métachromatique, les unes constituant l'article terminal des poils, peu apparentes, caractérisées seulement par leur contenu; les autres très évidentes, naissant dans le subpellis, 25-60(-100) x 4-8 µm, cylindracées, obtuses. **Revêtement du stipe** plus mince que celui du chapeau, mais tout à fait semblable, bien qu'un peu plus enchevêtré, à éléments plus grêles et plus longs.

Brésil : Amazonas, Manaus, en forêt secondaire, juin 1977, Singer B9933 (INPA).

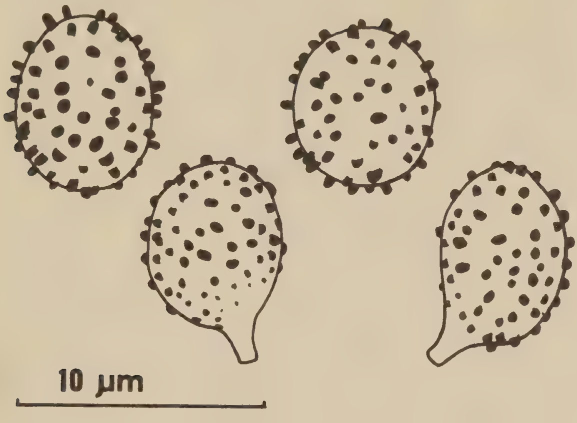


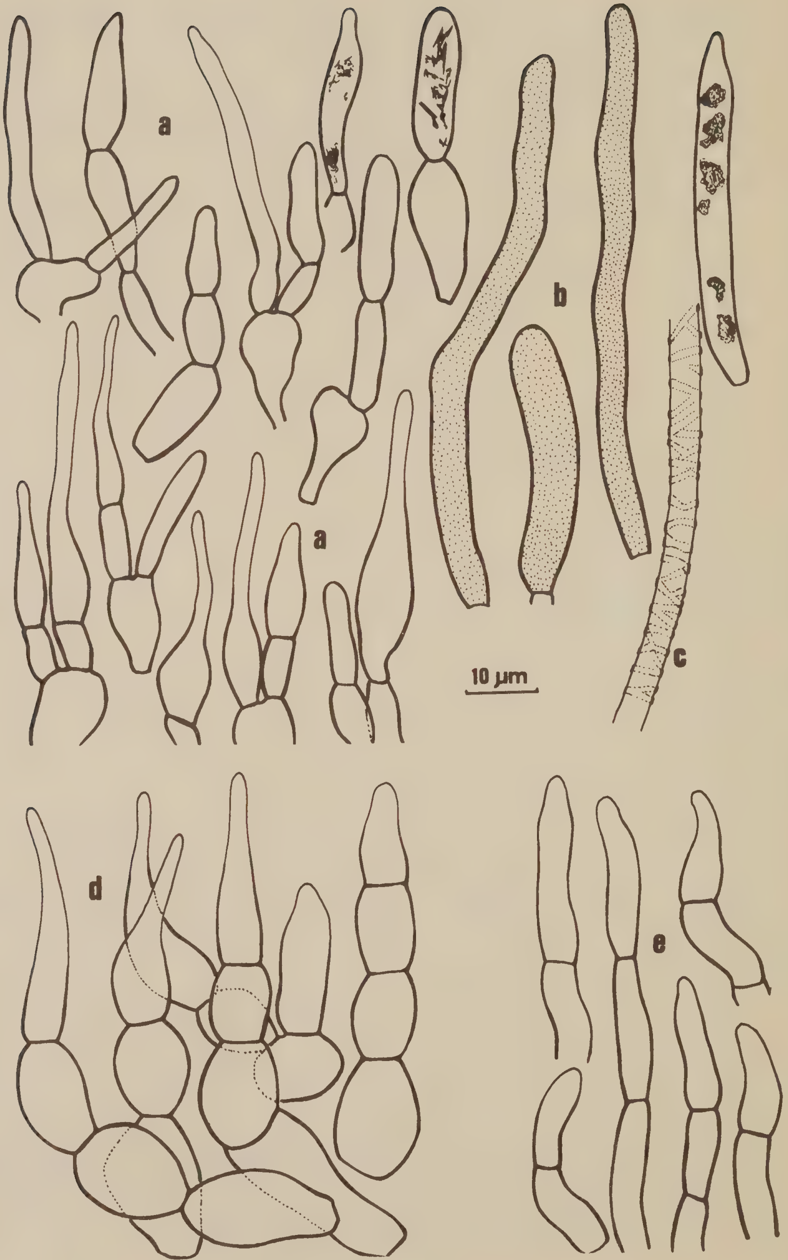
Fig. 1 : *R. pluvialis.* Ornementation sporale, observée dans le réactif de Melzer.

RUSSULA LEGUMINOSARUM Singer, Beihefte Nova Hedw : 227-229 (1983).

Caractères microscopiques - Fig. 4 - 6.

Spores brièvement ellipsoïdes à allongées, 8,03 ± 1,23 x 7,16 ± 1,01 µm (Q = 1,12), verruqueuses, à verrues isolées, obtuses, relativement espacées, assez grosses, atteignant 1,5 µm de haut, nettement amyloïdes; plage peu nette, plutôt arrondie, non amyloïde, verruculeuse. **Basides** 35-40 x 9-11 µm, peu volumineuses, tétrasporiques,

Fig. 2 (au verso) : *R. pluvialis.* a : Poils et cystides du revêtement piléique au centre du chapeau; b : endocystides du revêtement piléique; c : hyphe à incrustations transversales et métachromatiques au bleu de crésyl; d : poils du revêtement piléique près de la marge; e : poils du revêtement du stipe.


a
b
a
c
10 µm
d
e

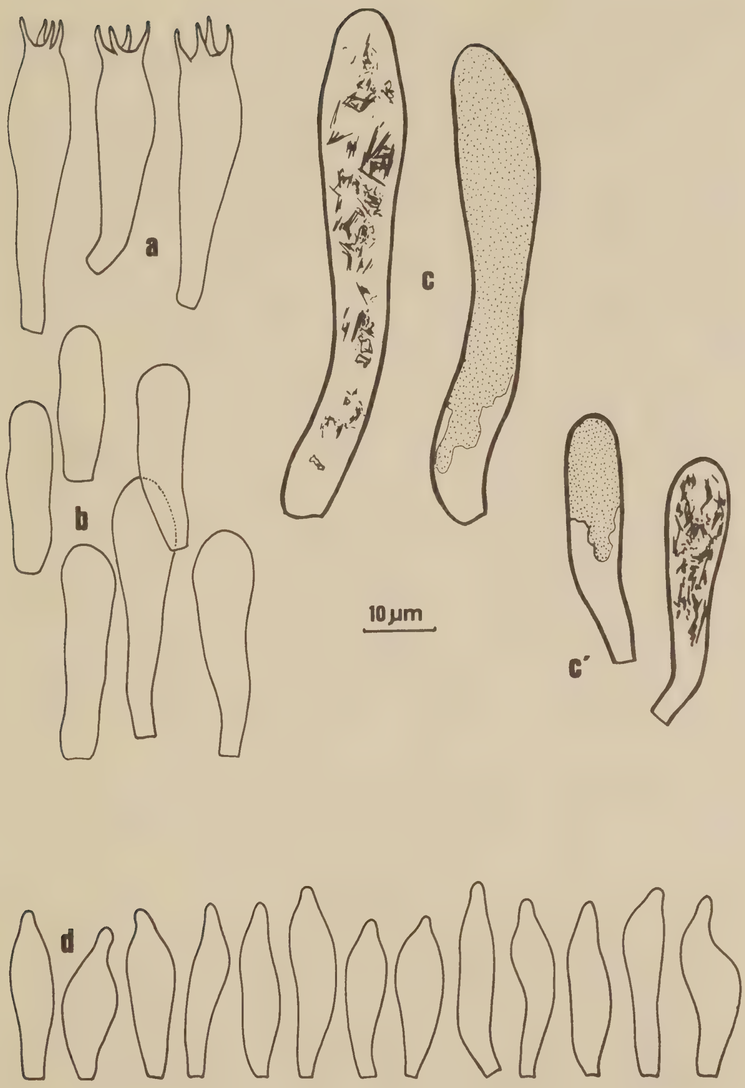


Fig. 3 : *R. pluvialis*. a : Basides; b : basidioles; c : cystides faciales; d : cystides près de l'arête; e : poils cystidiformes de l'arête.

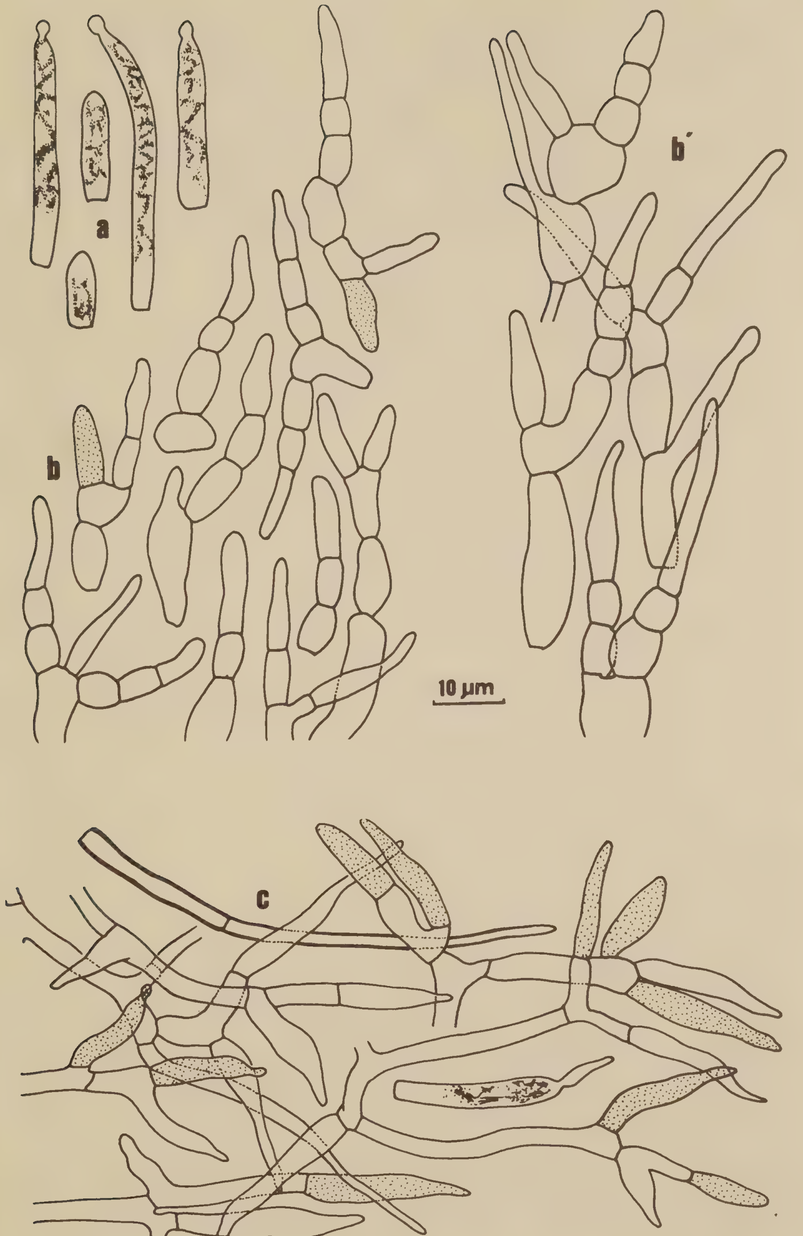
légèrement clavées, généralement optiquement vides, parfois avec quelques globules de dimensions variables; stérigmates très forts, 5-6 x 2-3 µm, aigus; basidioles allongées, clavées, souvent à contour un peu irréguliér ou sinueux en coupe optique. **Poils cystidiformes** de l'arête très nombreux, mesurant 16-35(-45) x 4-6 µm, versiformes, assez souvent fusiformes à fusiformes - ventrus, sinueux, obtus à longuement appendiculés au sommet, légèrement réfringents, à paroi mince. **Cystides** assez abondantes, (42-)47-55 x 7-11 µm, les plus petites près de l'arête, fusiformes, appendiculées - mcronées au sommet, à paroi très mince et fragile; avec quelques inclusions pailletées - réfringentes. **Revêtement piléique** composé d'hyphes emmêlées, 3-5 µm diam., écartées par une forte gélification, émettant un suprapellis discontinu de poils en touffes, formés d'articles globuleux, ellipsoïdes, à paroi mince et légèrement métachromatique au bleu de crésyl, naissant le plus souvent par plusieurs d'une même cellule basale, celle-ci nettement plus volumineuse; l'article terminal généralement un peu plus long, parfois jusqu'à 100 µm (surtout près de la marge piléique), lagéniforme, conique ou graduellement atténué vers le sommet, obtus. Dermatocystides assez abondantes mais peu apparentes, constituant le plus souvent l'article terminal des poils, 10-50 x 3-5 µm, cylindracées, parfois coniques, généralement capitées au sommet, à paroi mince et contenant quelques trainées granuleuses - réfringentes. **Revêtement du stipe** composé d'hyphes de 2,5-5 µm diam., emmêlées, émettant un suprapellis assez mince mais compact, confus, formé de poils grêles, fortement ramifiés, entremêlés; les articles s'amincissant progressivement vers le sommet; le terminal parfois longuement effilé, très grêle. Dermatocystides comme dans le chapeau.

Brésil : Amazonas, Estrada Manaus-Caracarai, km 45, dans la litière de Leguminosae dans une végétation du type 'campinaran' et 'campina', janvier 1979, Singer B11485 (INPA).

DISCUSSION

(1) : En comparant les données de Singer (l.c.) avec les nôtres, on peut voir qu'elles s'accordent assez bien; nos mesures, certainement celles des spores, étant néanmoins un peu en dessous de celles de Singer. Mais on sait que Singer compte généralement les ornements dans ses mesures de spores, et la différence n'est peut-être qu'apparente.

Fig. 4 (en face) : *R. leguminosarum*. a-b : dermatocystides et poils du revêtement piléique au centre du chapeau; b': Poils du revêtement piléique vers la marge du chapeau; c : Eléments du revêtement du stipe; dermatocystides marquées par un contenu finement granulé.


a
b
b´
10 µm
c

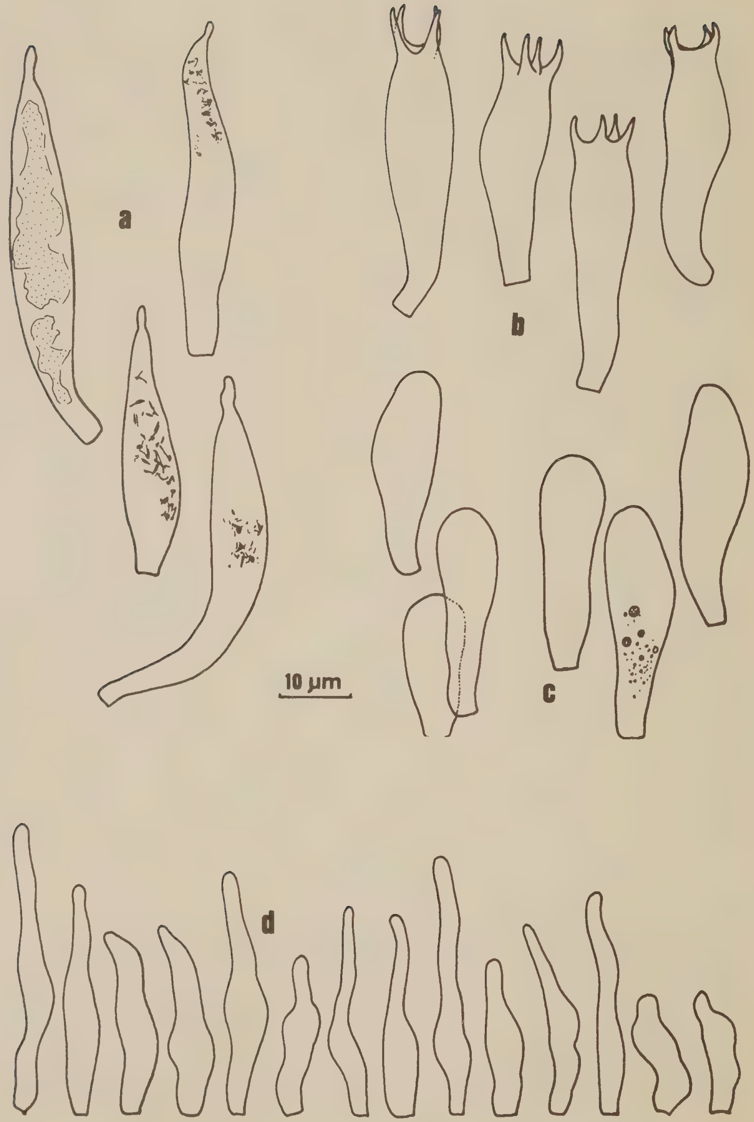


Fig. 5 : *R. leguminosarum.* a : cystides hyméniennes; b : basides; c : basidioles; d : poils cystidiformes de l'arête.

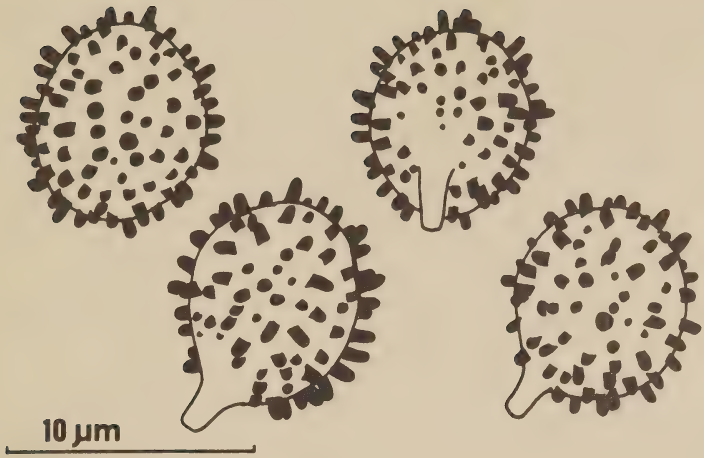


Fig. 6 : *R. leguminosarum.* Ornementation sporale, observé dans le réactif de Melzer.

R. PLUVIALIS	Singer (1983)	nos mesures
spores	7-8,2(9,5) x 6-7(8,5) µm	7,01 x 5,82 µm
basides	32-39,5 x 7,3-9,5 µm	30-40 x (8-)9-10 µm
cystides faciales	30-84 x 6-12 µm	40-80(120) x 8-12(15) µm
poils de l'arête	non observés ?	29-30 x 4-8 µm

R. LEGUMINOSARUM	Singer (1983)	nos mesures
spores	9-10,7 x 8,5-9,9 µm	8,03 x 7,16 µm
basides	32-44 x 9,5-11 µm	35-40 x 9-11 µm
cystides faciales	48-55 x 6,5-8,5 µm	(42-)47-55 x 7-11 µm
poils de l'arête	non observés ?	16-35(-45) x 4-6 µm

(2) : Comme on peut déduire déjà des descriptions ci-dessus, les différences entre les deux espèces sont plus importantes que ne le ferait supposer la diagnose très sommaire de *R. leguminosarum* (a *R. pluviali* praesertim stipite albo differt). Tout d'abord, seul *R. pluvialis* possède d'abondantes dermatocystides sur tous les niveaux des revêtements; de plus les cystides hyméniennes, ainsi que les dermatocystides sont fermes, à paroi épaissie. Dans *R. leguminosarum* ces éléments sont plus petits, peu apparents, très fragiles, à paroi nullement épaissie. Dans sa diagnose de *R. pluvialis* Singer dit "epicute structura Virescentinarum gaudente", ce qui n'est plus du tout le cas pour *R. leguminosarum.* L'ornementation sporale est décrite comme "sporis echi-

natis vel reticulatis", bien que je n'aie pas réussi à trouver des connexifs, ni dans l'un, ni dans l'autre type. En plus, les stérigmates des basides sont nettement plus volumineux chez *R. leguminosarum.* Les deux espèces possèdent un suprapellis à poils légèrement métachromatiques au bleu de crésyl. Dans le subpellis des hyphes à zébrures transversales, fréquentes chez *R. pluvialis*, manquent totalement chez *R. leguminosarum.* Ces zébrures transversales des hyphes et des dermatocystides sont souvent métachromatiques au bleu de crésyl; elles sont même nettement visibles dans le Congo ammoniacal.

(3) : Singer approche *R. pluvialis* de *R. carmesina* Heim, de *R. madegassensis* Heim et peut-être aussi de *R. congoana* Patouillard. Les différences dans la structure des revêtements et des lamelles chez ces espèces - qui toutes trois ne sont connues que du type - infirment des relations supposées.

(4) : *R. leguminosarum* au contraire est certainement très proche, sinon conspécifique de *R. mimetica* Heim. Cette dernière est décrite du Gabon (Heim, 1970) et est à peu près identique dans tous les caractères microscopiques. Heim (l.c.) la situait à côté de *R. heliochroma* dans les *Heliochrominae.* Malheureusement, une comparaison entre les caractèristiques macroscopiques de *R. leguminosarum* et *R. mimetica* n'est pas encore possible, car *R. mimetica*, prise pour *R. annulata* ssp. *parasitica* Heim (espèce à anneau fugace !) au moment de la récolte, n'a pas bénéficié de notes prises sur le vif.

REMERCIEMENTS

Je tiens à remercier le directeur de l'herbier de l'Instituo Nacional de Pesquisas de Amazonia, Manaus (INPA) pour le prêt du matériel, ainsi que le Prof. Dr. P. Van der Veken et le Prof. Dr. P. Heinemann qui nous ont fait part de leurs observations après une lecture critique du manuscrit.

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STUDIES IN THE GENUS PHOMA. XIV. CONCERNING PHOMA HERBARUM, THE TYPE SPECIES, A WIDESPREAD SAPROPHYTE.

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ABSTRACT

The type species of *Phoma* Sacc., *P. herbarum* Westd., an ubiquitous saprophyte on decaying plant material and other substrates, is redescribed and illustrated. Its distinguishing characteristics *in vitro* are noted and an account given of its pycnidial wall anatomy.

INTRODUCTION

As noted previously (White and Morgan-Jones, 1984; Morgan-Jones and Burch, 1988b), a number of *Phoma* species occur on a wide range of host plants, on other substrates, and some are soil-borne. These ubiquitous fungi are cosmopolitan in distribution and some, in the past, because of being plurivorous and known only *in vivo*, have been confused with each other. The commonest species include *P. eupyrena* Sacc., *P. exigua* Desm. var. *exigua*, *P. glomerata* (Cda) Wollenw. & Hochapf., *P. herbarum*, *P. macrostoma* Mont., and *P. sorghina* (Sacc.) Boerema, Dorenbosch & van Kesteren. All these, with the exception of *P. herbarum*, have already been redescribed in this series of papers (Morgan-Jones and Burch, 1988a, 1988b; White and Morgan-Jones, 1983, 1984, 1987). In the present paper, *P. herbarum* is treated.

Phoma herbarum Westd. is the lectotype species of the conserved generic name *Phoma* Sacc. (Lanjouw *et al*., 1956). Although the binomial *P. herbarum* has been widely used for well over a century (e.g. by Saccardo, 1884; Allescher, 1900; and Grove, 1935), the characteristics of the fungus on which it is based were not adequately understood until Boerema (1964) conducted type studies and selected lectotype material for the name. As a result, the fungus has an extensive nomenclature and there is little doubt that the binomial *P. herbarum* has frequently been misapplied to other *Phoma* species, particularly the ubiquitous *P. exigua* var. *exigua* (Boerema, 1976). Over eighty "formae" and varieties have been described in *P. herbarum*, most of them misplaced, and many based on *P. exigua* (Boerema, 1970, 1976). Because of the fact that it occurs on such diverse substrates as soil, milk, butter and paint, as well as on dead herbaceous and woody plants, it has had many binomials applied to it. Names such as *P. hibernica* Grimes, O'Connor & Cummins, described from butter, *P. lignicola* Rennefelt, isolated from wood pulp, and *P. pigmentivora* Massee and *P. violacea* (Bertel) Eveleigh [≡ *Aposphaeria violacea* Bertel], both known from

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paint, are now all accepted as being based on *P. herbarum* and are listed as synonyms of it (Boerema, 1964).

The oldest name to be given the fungus presently known as *P. herbarum* appears to be *Phoma exigua* var. ('b') *minor* Desm. [*Ann. Sci. Nat.*, ser. 3, 11: 283, 1849] (Boerema, 1970). Although this antedates *P. herbarum*, the epithet '*minor*' cannot, however, be taken up because of its varietal status and the fact that it does not have priority outside its own rank.

Boerema (1964) found the original material of *P. herbarum* to consist of pycnidia on stems of two different hosts, *Onobrychis viciifolia* Scop. and *Urtica dioica* L., and chose the former as lectotype. The latter was found to bear two distinct pycnidial fungi, one matching that on *O. viciifolia* and the other with larger conidia. Several other species of *Phoma*, namely *P. hoehnelii* van Kesteren var. *urticae* Boerema & van Kesteren [teleomorph = *Leptosphaeria doliolum* (Pers.: Fries) Ces. & de Not. var. *doliolum*], *P. nebulosa* (Pers.) Berk., and *P. urticicola* van der Aa & Boerema [teleomorph = *Didymella urticicola* van der Aa & Boerema], in addition to *P. herbarum*, occur on *U. dioica* (Boerema, 1976). Some of the confusion surrounding the true characteristics of *P. herbarum* was attributed by Boerema (1964) to the fact that Saccardo (1884), who was presumed to have examined a syntype of *P. herbarum* on *U. dioica* extant in his herbarium, gave larger conidial dimensions than those typical of the species. The syntype was found by Boerema (1964) to bear, in addition to *P. herbarum*, the second pycnidial fungus with larger conidia. Thus, subsequent identifications and characterizations, based on Saccardo's measurements [as in Allescher (1900) and Grove (1935)], often undoubtedly refer to other fungi.

To complicate matters, the name *P. herbarum* has not only been extensively misapplied, but the fungus on which it is based, as alluded to above, has been given numerous other binomials and some of those have themselves been misapplied. Both *P. urticae* Schulz. & Sacc. and *P. oleracea* Sacc., two names published during the last century and used or misapplied relatively frequently in the literature, are now also considered to be synonyms of *P. herbarum* (Boerema, 1964, 1970, 1976). The distinction between *P. oleracea* and *P. lingam* (Tode) Desm., the causal organism of dry rot of turnip and swede and black leg of cabbage, has been the subject of some discussion (cf. Henderson, 1918; Cunningham, 1927; Grove, 1935) and it has generally been believed, incorrectly, that the two are identical. Grove (1935) considered *P. lingam* to be "probably a mere form of" *P. oleracea*. The binomial *P. oleracea* had previously often been incorrectly used for *P. lingam* (e.g. by Bos, 1906; Manns, 1911; Harter, 1912). Both Manns (1911) and Harter (1912) attributed black-leg disease of cabbage in the United States to *P. oleracea*, but Henderson (1918) took up the name *P. lingam* for the disease-inducing fungus, listing *P. oleracea* as a synonym. The view that the two were the same came to be held, in large part, because both *P. herbarum* (as *P. oleracea*) and *P. lingam* were known to share common hosts, species of *Brassica* L. Less attention to host specificity and more to the morphology of the respective fungi would have indicated the two to be different. Cunningham (1927) compared isolates of *P. lingam* and *P. oleracea*, obtained from the Centraalbureau voor Schimmelcultures, and found the latter to be non-pathogenic but assumed it to be an aberrant form of *P. lingam* that had acquired capacity to produce abundant pycnidia *in vitro* and lost its pathogenicity! As with *P. herbarum*, a number of "formae" and varieties of *P. oleracea* have also been described, mainly on the basis of occurrence on different host plants. Most of these are regarded as synonyms of *P. herbarum* (Boerema, 1970).

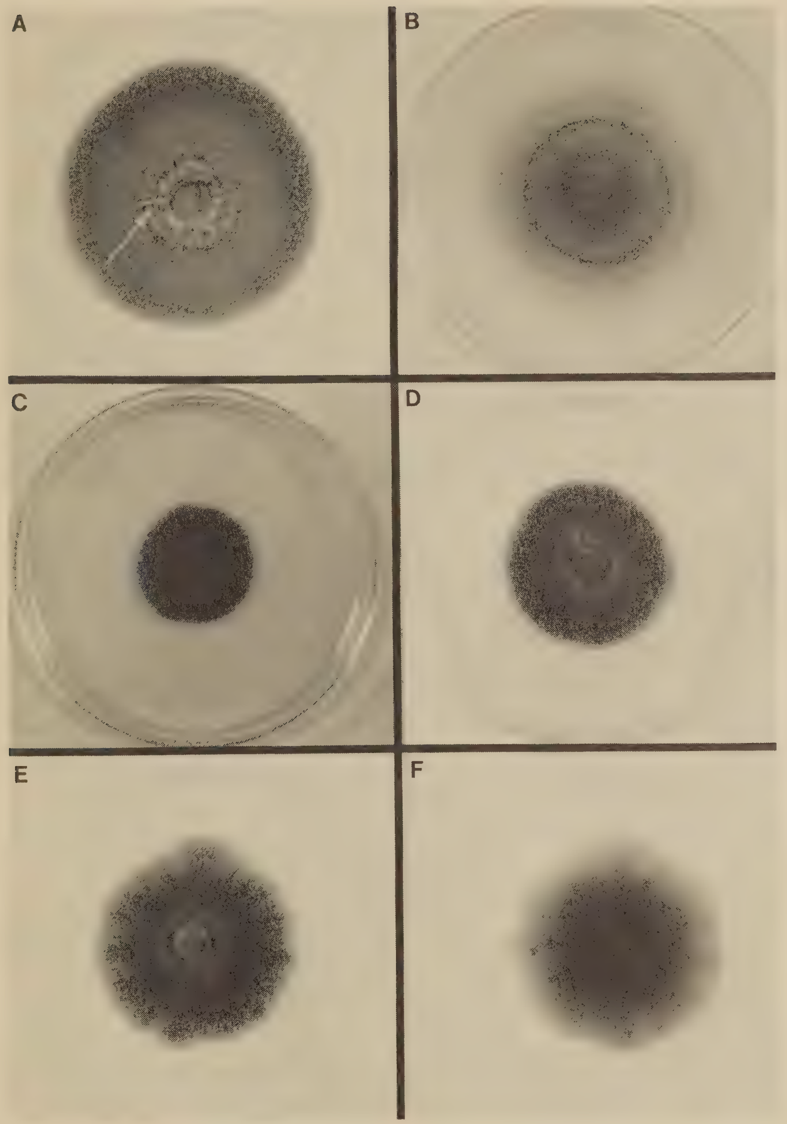


PLATE 1. *Phoma herbarum.* A, 21-day-old colony on PDA at 25C (confluent conidial masses toward colony center indicated by arrow); B, 21-day-old colony on cellulose agar at 20C; C, 14-day-old colony on PDA at 20C; D, 21-day-old colony on PDA at 20C; E, 21-day-old colony on MEA at 25C; F, reverse of same.

Dennis (1946), in his studies on *Phoma* species *in vitro*, gave some account of the characteristics of *P. herbarum* although he did not use this name. Three isolates assigned to his Group X (strains 25-27) were recognized to be similar, particularly in producing abundant pycnidia and sparse aerial mycelium. One strain was thought to be *P. urticae*, one to probably correspond to collections of a *Phoma* identified by W.B. Grove as *P. oleracea*, and the third had been received from M. Grimes as *P. hibernica*. Dennis doubted, however, that *P. hibernica* was identical with the other two strains on account of conidial size differences although he recognized this criterion to be variable. Eveleigh (1961) gave further account of *P. herbarum* [as *P. violacea*] in culture, based on isolates obtained from painted surfaces, and Sutton (1964) described it [as *P. herbarum* var. *lactaria* Sutton] isolated from rubber tubing of a milking machine.

Nicot-Toulouse (1952) considered *P. violacea* (as *A. violacea*) and *P. hibernica* to be different on the basis of pycnidia of the former being produced superficially on agar, whereas those of the latter were said to be immersed. Boerema (1970), however, documented this characteristic to be highly variable and could find no difference in this regard between isolates of *P. herbarum* originating from plant material and paint. No isolates were found that produced pycnidia entirely on the surface of various agar media, each forming at least some immersed pycnidia.

During the course of a survey of fungi associated with biodeterioration of carpet, plaster-board and wallpaper in hotels in the southeastern United States (Morgan-Jones and Jacobsen, 1988), *P. herbarum* was encountered on the damp under-surface of carpet at one location and isolated in pure culture. I have also had opportunity to examine an isolate originating in Europe.

TAXONOMIC PART

Phoma herbarum Westd., *Bull Acad. Belg.* 19: 118, 1852 (Plates 1 and 2, figure 1).

= *Phoma oleracea* Sacc., *Michelia* 2: 91, 1880.

= *Phoma urticae* Schulz. & Sacc., *Hedwigia* 23: 91, 1884.

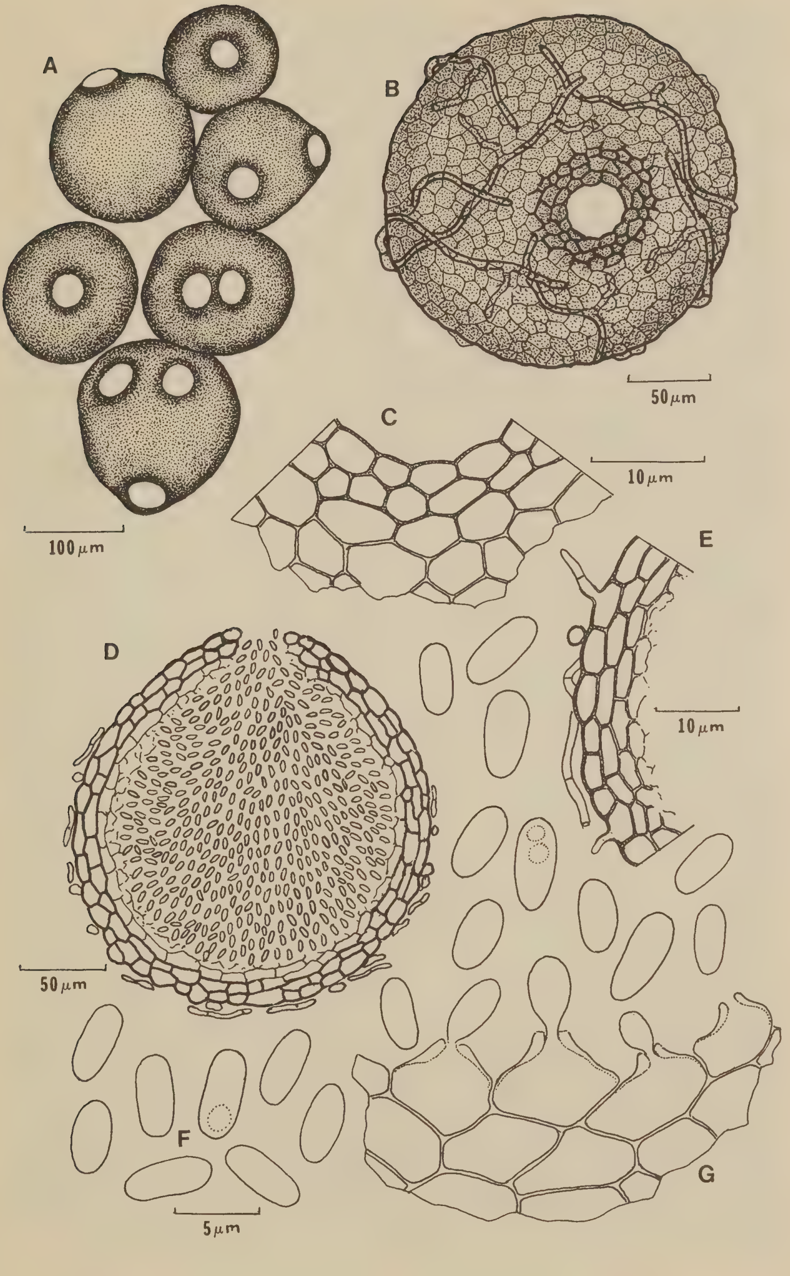
= *Aposphaeria violacea* Bertel, *Öst Bot. Z.* 54: 205, 1904.

≡ *Phoma violacea* (Bertel) Eveleigh, *Trans. Br. mycol. Soc.* 44: 577, 1961.

= *Phoma pigmentivora* Massee, Bull. misc. Inf. R. Bot. Gdns Kew 8: 326, 1911.

= *Phoma hibernica* Grimes, O'Connor & Cummins, *Trans. Br. mycol. Soc.* 17: 99, 1932.

FIGURE 1. *Phoma herbarum.* A & B, pycnidia from 14-day-old colonies on cellulose agar; C, surface view of pycnidial wall in vicinity of ostiole; D, V.S. pycnidium; E, portion of pycnidial wall in section; F, conidia; G, conidiogenous cells.


A
B
50 μm
C
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D
10 μm
50 μm
F
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G

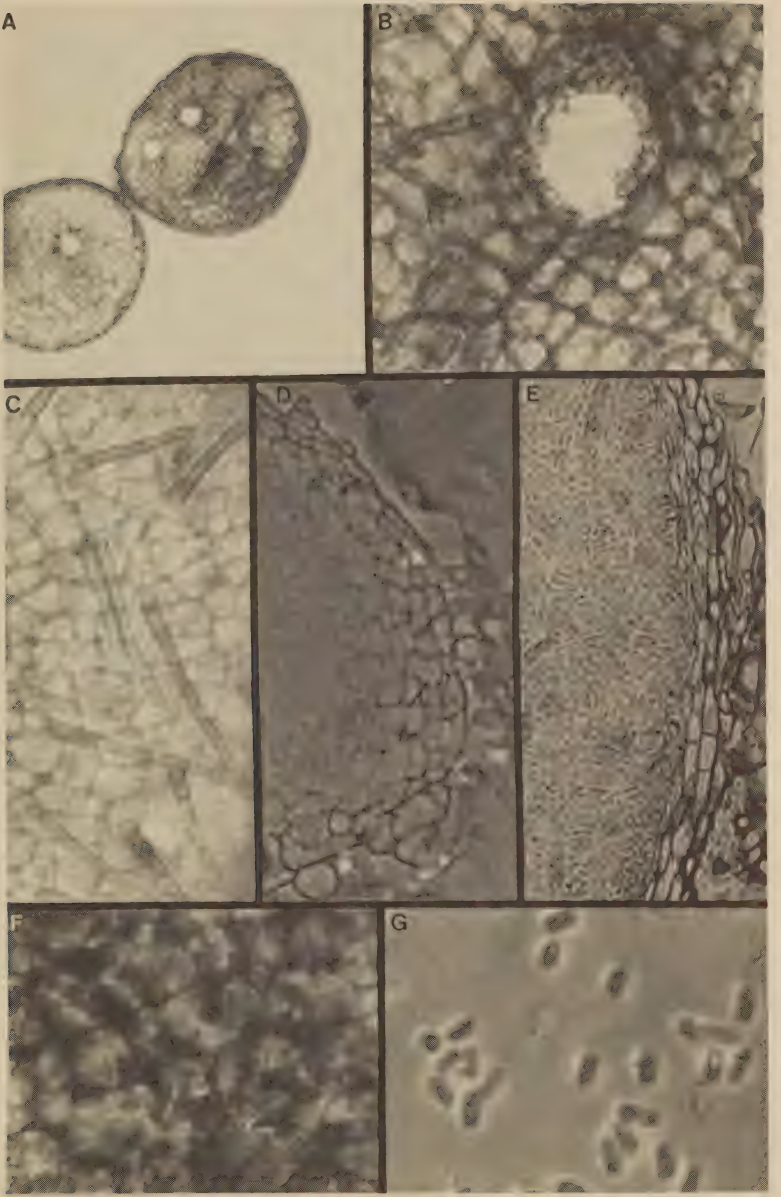
[For additional synonyms, see Boerema 1964, 1970.]

Colonies on potato dextrose agar [Difco] relatively slow-growing (Plate 1, A, C & D), grey to olivaceous, with a paler marginal zone, becoming darker to charcoal grey with pycnidial maturation, margin even, aerial mycelium generally sparse, surface eventually appearing slimy as a result of production and confluence of abundant conidial masses, sometimes producing pale yellowish brown to reddish diffusible pigment, attaining a diameter of 20 mm at 20C after 7 days, 21 mm at 25C, and 10 mm at 30C; after 14 days at 25C, 46 mm in diameter. Reverse dark olivaceous to blackish, often mottled due to pycnidial production. Colonies on PDA grown at 20C generally darker and with somewhat less aerial mycelium than when grown at 25C. Colonies on malt extract agar [Difco] (Plate 1, E) with very little aerial mycelium, olivaceous, finely striated, attaining a diameter of 18 mm at 20C after 7 days, 21 mm at 25C, and 10 mm at 30C. Colonies on cellulose agar extremely thin. Pycnidia produced abundantly on PDA and cellulose agar, slightly less so on MEA, varying considerably in size. On PDA after 21 days a dense crust of pycnidia usually present. Mycelium composed of subhyaline to pale yellowish-brown, branched, smooth, 1.5-3.5 µm wide hyphae. Pycnidia (Plate 2, A) mostly superficial on agar surface, solitary or more frequently, densely gregarious, varying in shape from subglobose to elongated or somewhat irregularly lobed, yellowish brown, becoming darker with age and eventually blackish on some media such as oatmeal agar, pseudoparenchymatous, unilocular, uniostiolate or with up to four ostioles, nonpapillate or very slightly papillate, often covered by a loose weft of hyphae and sometimes bearing short, scattered hyphal outgrowths of outer pycnidial wall cells, 100-350 µm in diameter. In older pycnidia on cellulose agar seta-like attenuated hyphal outgrowths (Plate 2, C) originating from outer pycnidial wall cells frequent. Ostioles circular, prominent, surrounded by darker-walled, more or less isodiametric, 4-6 µm wide cells, 15-30 µm in diameter (Plate 2, B). Pycnidial wall (Plate 2, D & E) composed of ellipsoid to oblong cells, three to four layers thick, having, in places, when mature, something of a "textura prismatica" (*sensu* Starbäck, 1895) appearance with some individual cells more or less brick-shaped; outer layer made up of thick-walled 6-9 µm wide cells around and in between which, when mature, substantial deposits of melanin occur, inner layer made up of thin-walled, flattened cells. Conidiogenous cells phialidic, hyaline, doliiform, with a thickened, striated periclinal wall (see Boerema and Bollen, 1975), borne on inner cells of the pycnidial wall. Conidia ellipsoid, straight, smooth-walled, hyaline, mostly eguttulate, 4-5 X 1.5-2 µm, rarely reaching a length of 9 µm. Conidial masses whitish to cream-colored or faintly pinkish, readily oozing out of and covering pycnidia, eventually forming a confluent, coagulated crust.

Plurivorous; cosmopolitan.

Collections examined: isolate from under-surface of damp, discolored carpet, Cabot Lodge, Tallahassee, Florida, U.S.A., B.J. Jacobsen, December 1987, AUA; isolate from cutting of *Chrysanthemum indicum* L., Lier, The Netherlands, G.H. Boerema, 1965, PD 65/679, AUA.

PLATE 2. *Phoma herbarum*. A, Pycnidia from cellulose agar colony; B, surface view of pycnidial wall in vicinity of an ostiole; C, surface view of pycnidial wall with seta-like hyphae originating from outer cells; D, portion of wall of young pycnidium in section; E, portion of wall of mature pycnidium in section; F, surface view of mature pycnidium showing melanin deposits; G, conidia.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DISCUSSION

Although found on widely diverse substrates, *P. herbarum* is among the easiest *Phoma* species to identify when grown *in vitro*. It has a number of distinctive characteristics which, in combination, make it unmistakable. The main diagnostic features are slow colony growth rate, abundant production of gregarious pycnidia, general lack of aerial mycelium and possession of small, mostly eguttulate conidia. As is the case with most other species, some isolates deviate to various degrees from what can be considered the norm, particularly in colony appearance. Some produce more aerial mycelium than others and some cultures may produce sectors with dense mycelium lacking pycnidia. Growth rate is, however, relatively consistent. On cellulose agar (see Morgan-Jones and White, 1983; Eggins and Pugh, 1962) at 20C and 25C, after three weeks, colony appearance is particularly distinctive (Plate 1, B). Very little aerial mycelium is produced, but abundant, entirely superficial, gregarious pycnidia are present. The distinctly ostiolate pycnidia and the pycnidial wall anatomy are other useful diagnostic criteria. As has been mentioned previously (White and Morgan-Jones, 1987, Morgan-Jones and White, 1987), pycnidial wall anatomy is a very useful characteristic for species definition within *Phoma*. Although some changes occur in shape and wall thickness of cells constituting the wall as conidiomata mature, each species is sufficiently different in final organization and appearance as to be readily distinguishable. The tendency for deposits of melanin to accumulate around the cells forming the outer pycnidial wall layer in older conidiomata is a feature that *P. herbarum* shares in common with *P. nebulosa* (Pers.) Berk. and *P. terrestris* Hansen.

Production of some diffusible pigment can be considered typical of *P. herbarum*, but its coloration varies and some isolates fail to produce any (Dorenbosch, 1970). Pigment, where present, varies from pale yellowish brown to orange-red to reddish-violet, depending upon the isolate, medium pH and available light (Eveleigh, 1961; Boerema, 1964; and personal observation). Pigment is often well developed on such media as cornmeal and oatmeal agar and strong pigmentation is often associated with abundant aerial mycelium (Boerema, 1964). Application of a drop of NaOH to a colony producing strong, diffusible reddish pigment results in a color change to blue (Dorenbosch, 1970). In old cultures, the red pigment changes to a bluish hue naturally.

Isolates of *P. herbarum* (as *P. violacea*), originating from painted surfaces, were separated by Eveleigh (1961) into three groups according to color of conidial masses. A large number had orange-pink conidial masses, one had conidia exuding as yellow tendrils and one had milky white, slimy masses. The orange-pink group was subdivided into four sections based on colony appearance on malt agar. Differences in pigment production were also detected, some isolates showing none, others discoloring the agar medium brown or red. It is clear that *P. herbarum*, as is the case with most other *Phoma* species, is quite variable *in vitro*. Five additional isolates, three from paint, one from concrete and one from soil, were distinguished by Eveleigh from those named *P. violacea* on the basis of "flat colony growth and black aerial mycelium on wispy malt agar." These were considered to represent a new species, and the name *P. saprophytica* Eveleigh was established for them. This is now recognized to be a synonym of *P. glomerata* (Cda) Wollenw. & Hochapf. (Boerema *et al.*, 1965).

Phoma herbarum, although recorded on many plants and known to be present in seed coats and in the rhizosphere, is generally considered to be a saprophyte (Dorenbosch, 1970; Boerema, 1976; Domsch *et al.*, 1980). It is unique in having a wide substrate range that includes activated sewage sludge, cement, oil paint, paper, rubber and wood (Boerema, 1976; Diener *et al.*, 1976; Domsch *et al.*, 1980). It has been implicated as a causal organism of soft-rot in wood (Duncan and Eslyn, 1966).

ACKNOWLEDGMENTS

I thank Dr. G.H. Boerema, lately of Plantenziektenkundige Dienst, Wageningen, The Netherlands, for providing me with an isolate of *P. herbarum*. Dr. J. Leland Crane, Illinois Natural History Survey, Champaign, Illinois, reviewed the manuscript.

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MACROCHEMICAL COLOR REACTIONS OF MACROMYCETES

VI. Cluster analysis of color data

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Summary

The color atlas of Küppers (1984) is recommended as a reference to codify colors in mycology. The numerical values of the coordinates in its logically arranged, 3-dimensional color space can be used as computer input data for classification procedures. The practical use is demonstrated with a data set of 25 species of Russula and Amanita.

Introduction

Colors are important features in mycology, e.g. the color of the spore print, of the pileipellis, of the mycelium in culture, or the colors developing after the application of different chemical reagents. Such characters are frequently used for numerical taxonomy, e.g. by Clémençon (1984), Fiasson & Niemelä (1984), Wolfe Jr. (1984), Mueller (1985). Generally, continuously scaled characters like spore dimensions are mixed with discrete values like the 1-bit-decision "with annulus or without annulus", and there is no mathematical problem to use them together in the estimation of some taxonomic distance criterium.

However, one difficulty remains. How can characters like color, odour or taste be expressed by numbers without loss of information? Most cluster algorithms use numerical differences between the input parameters, and the distance matrices of N characters express the similarities of the objects. Obviously, these matrices are significantly influenced by the codification procedure of the original values. Contrary to the common practice in mycology hitherto known to us from the literature, it is impossible to arrange colors in a simple linear order that is to approach the visually conceived distances between them.

This can be well done in a 3-dimensional color space (Küppers 1984, DIN 1985) where additionally saturation and lightness do not count out.

It is the aim of this paper to show how an intrinsic taxonomic information hidden in the reaction colors can be extracted by means of common mathematical procedures if such a color atlas was used to codify the results of spot tests. But it should be stated very clearly that the problem of an unambiguous evaluation of physiological color distances is not yet solved (Witt 1983/84).

Mycological data set

17 specimens of the genus Russula Pers. and 8 specimens of the genus Amanita Pers. ex Hook. were examined as described in Part I (Frank 1987) and the resulting colors were codified by comparing them with the color atlas of Küppers (1984), as described in Part II (Frank 1986). In the latter the reaction patterns of several Russula species are given used again here. In this paper only the reactions with $FeSO_4$ (FES), $AgNO_3$ (AGN), 1-naphthol (NAP), benzidine (BEN) and guaiacol (GCL) are utilized as taxonomic parameters. The nomenclature of the fungi follows Kreisel (1983).

1 Russula chloroides Krbh. : Part II.
2 Russula nigricans (Bull.)Fr. : FES greyish pink 10.20.05, AGN purple violet 20.85.75, NAP blue violet 00.50.50, BEN rapidly dark blue 30.30.99, GCL rapidly brick-red 30.55.00.
3 Russula densifolia (Barla)Gill. : FES greyish pink 20.25.10, AGN strong chocolate 50.80.80, NAP dark violet 20.80.70, BEN bright blue 10.00.90, GCL dull red 25.50.20.
4 Russula fellea (Fr.)Fr. : Part II.
5 Russula ochroleuca (Pers.)Fr. : Part II.
6 Russula virescens (Schaeff.)Fr. : Part II.
7 Russula cyanoxantha (Schaeff.)Fr. : Part II.
8 Russula heterophylla (Fr.)Fr. : Part II.
9 Russula grisea (Pers.)Fr. : FES instantly light ruby 30.40.20, AGN pale pink 10.10.00, NAP blue violet 00.50.50, BEN light blue 10.00.50, GCL greyish pink 10.30.10.
10 Russula xerampelina (Schaeff.)Fr. : Part II.
11 Russula viscida Kudrna : FES instantly greyish pink 20.30.05, AGN pale greyish lilac 05.20.00, NAP lilac violet 10.50.50, BEN dark blue 30.30.99, GCL brownish pink 20.25.10,
12 Russula caerulea (Pers.)Fr. emend. Cke. : Part II.
13 Russula velenovskyi Melzer & Zvara : FES instantly pink 25.40.00, AGN vinaceous 10.50.15, NAP blue violet 00.50.50, BEN bright blue 10.00.80, GCL vinaceous red 20.60.40.
14 Russula carpini Heinemann & Girard : FES pale pink

10.10.00, AGN dull lilac 05.20.05, NAP dark violet 30.70.80, BEN bright blue 10.00.80, GCL vinaceous brown 70.85.60.

15 *Russula emetica* (Schaeff.:Fr.)S.F.Gray : FES instantly fleshy colored 10.45.10, AGN reddish brown 35.50.40, NAP greyish lilac 20.25.35, BEN dull yellow 30.05.05, GCL red brown 60.60.40.

16 *Russula atropurpurea* (Krbh.)Britz. : Part II.

17 *Russula olivaceoviolascens* Gill. : FES instantly reddish 30.40.10, AGN greyish lilac 30.25.15, NAP violet 30.60.70, BEN bright blue 10.00.80, GCL dull orange 35.50.40.

18 *Amanita fulva* Fr. : FES -, AGN red brown 60.70.50, NAP -, BEN light blue 05.05.50, GCL -.

19 *Amanita muscaria* (L.)Pers. : FES -, AGN pink 05.20.05, NAP -, BEN -, GCL pale pink 10.10.00.

20 *Amanita pantherina* (DC:Fr.)Krbh. : FES -, AGN ochraceous yellow 30.10.00, NAP -, BEN -, GCL red brown 60.60.40.

21 *Amanita regalis* (Fr.)Michael : FES -, AGN -, NAP -, BEN -, GCL -.

22 *Amanita phalloides* (Fr.)Link : FES -, AGN pale lilac 02.15.05, NAP pinky 02.20.00, BEN -, GCL -.

23 *Amanita citrina* (Schaeff.)Pers. : FES -, AGN very pale grey 05.05.05, NAP pale pink 10.10.00, BEN -, GCL -.

24 *Amanita excelsa* (Fr.)Bertillon : FES -, AGN red brown 60.75.50, NAP -, BEN -, GCL -.

25 *Amanita rubescens* Pers.:Fr. : FES very pale yellowish 05.00.00, AGN strong chocolate 80.90.90, NAP -, BEN -, GCL -.

Mathematical procedure

In the atlas of Küppers (1984) the colors are arranged according to the optical density of the offset film, not according to their density on the paper. This means that the numbers given in the book to express the saturation of each color component are fixed only on an intermediate in the printing process. The significance of a reaction color certainly depends on its saturation too, and therefore it is necessary to express the colors by the real optical density of their 3 components (this is only a rough approximation of the physiological impression !). It was assumed that the differences between film and print are nearly the same for both the 3 color components and the grey scale given by Küppers. The following formula was found adequat for the transformation of this grey scale (columns A and C at page 138)

$$F_T = 101 \cdot \mathrm{SIN}\ (F \cdot 0.82)$$

where F is the declared color component identification number (column A) and F_T expresses the real density (column C) required above.

A matrix with 25 objects and 15 characters was obtained and, after normalization and autoscaling subjected to the agglomerative cluster program Average Linkage, with or without a foregoing Principal Component Analysis (PCA). The programs were created by Henrion & al. (1987), adapted by us and used on a Commodore 64.

Discussion

The result of clustering the 8 principal components (PC) representing about 96% of the initial variation of the F_T-values are given in Fig. 1. It should be noted that the x-axis distances are a yardstick for the similarity. Obviously the 2 genera are separated very impressively from another till the last step. R. fellea (#4) is a remarkable exception and forms the most distinctive cluster. This species is a somewhat atypical Russula because it lacks the enzymatic compounds which are responsible for the blue reaction with benzidine, but it gives a strong discoloration with silver nitrate. R. xerampelina (#10) is the only species of the genus incorporated in this study with a green discoloration after application of iron sulfate. A. pantherina (#20) can be distinguished from the other Amanita by its red brown reaction with guaiacol. And last but not least A. fulva, excelsa and rubescens (#18, 24, 25) are united in the same cluster due to their more or less deep brown discoloration after application of silver nitrate. The finer details of the dendrogram should not be interpreted taxonomically because the experimental data basis is to small.

The given dendrogram seems us to be the most realistic one due to the plausible mathematical approach and due to the common generic concept. Both clustering the starting matrix without foregoing PCA and clustering only 4 PC's representing about 73% of the initial variation yields a dendrogram far away from what is expected and given in Fig. 1.

It was demonstrated that the color data should be used as continuously scaled parameters for cluster analysis, because discrete and arbitrarily fixed values must be handled very carefully to avoid misinterpretation and speculation! Obviously, differences in the chemical behavior expressed by simple color reactions can support the systematical arrangement of the species under consideration in 2 genera. It is the intention of one of us (H.M.F.) to point out that such characters should not be neglected to determine and systematize fungi.

In the last 2 or 3 years the initial enthusiasm for numerical methods in taxonomy has smoothed down; the main reasons are both misinterpretation of the aim and exaggerated ecpectations in the infallybility of the mathematical apparatus. In this sense the phrase Computer Aided Taxonomy (CAT) can offer a new sympathy, because "One must

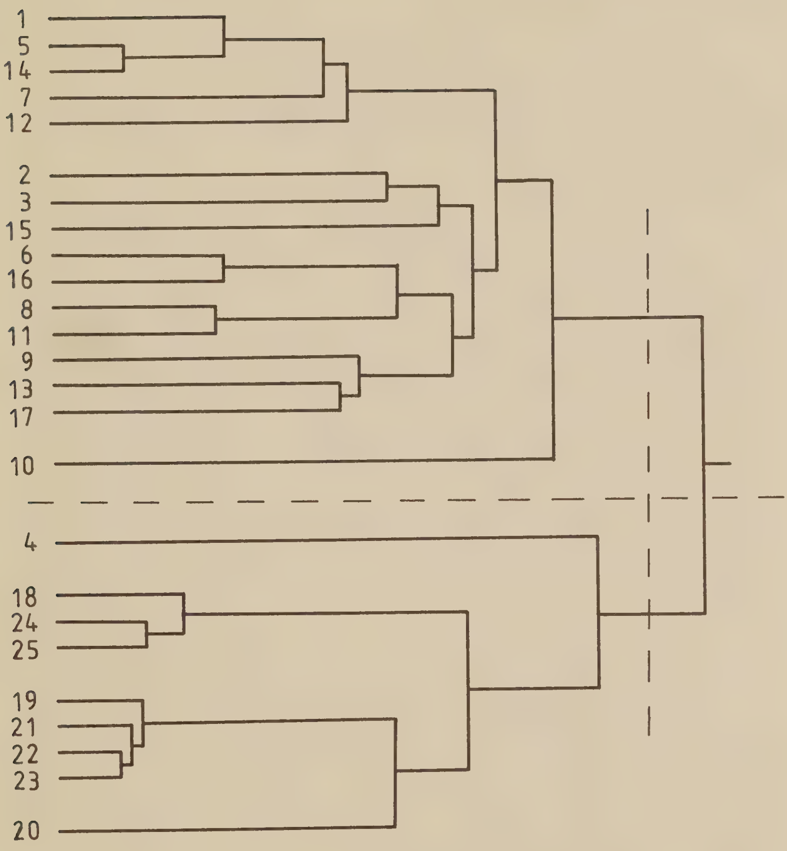
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Fig. 1. Dendrogram of the 8 principal components using the transformed color values (F_T-values).

For numbers see list of species.

be aware of the fact that CAT is an Aid to taxonomy making suggestions only, never dictating any kind of solution, just as the computer acts as a very sophisticated instrument returning only what the operator puts in, never creating something new." (Clémençon 1984)

Acknowledgement

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A note on Grelet's "Les Discomycètes de France"

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From 1932 to 1959 an important set of papers was published under the title "Les Discomycètes de France d'apres la classification de Boudier" by Louis-Joseph Grelet. Grelet, who died in January 1945 (Le Gal, Bull. Soc. Mycol. France 61: 103-107. 1945), began his studies of discomycetes in 1901 and soon became a disciple of the great French mycologist Emile Boudier. The purpose of the "Discomycètes de France" was to describe all the species of discomycetes - operculate and inoperculate - using the system devised by Boudier in his publications in the late 19th and early 20th Centuries. The best general source for the Boudier names and treatments is his Histoire et Classification des Discomycètes d'Europe which was published in 1907. As an aside, it should be noted that more than half of the fascicles appeared after Grelet's death. It is not known to me whether there was substantial editorial work done by others such as Heim or Le Gal on his manuscripts. The Grelet descriptions are of particular importance because of the detailed anatomical information they provide.

The first eight fascicles of the Grelet series, which began in 1932, were published in the obscure journal, Bulletin de la Société Botanique du Centre-Ouest; the remainder appeared in the Revue de Mycologie. The first fascicles were distributed also as repaged reprints. The series was reprinted in its entirety in 1979 by the Société Botanique du Centre-Ouest as New Series, Special Number 3. In the 1979 reprint, only minimal bibliographic information is given; pages are consecutively numbered (1-660). The reprint is indexed by genus and species using these page numbers. Because of the various forms in which the articles appeared and because of the rarity of the journal in which the first fascicles were printed, it often has been difficult to date fascicles accurately and to be confident of exact original pagination. Because some of the articles appeared in three forms--the journal, repaged reprints, and the 1979 reprint--it is easy to see that confusions might exist.

The journal is found in few libraries in North America and I am indebted to Ms. Rebecca A. Perry of the Lloyd Library (Cincinnati) for verifying dates and pages for me from the Lloyd Library set of the journal and for providing photocopies of portions not available at Harvard and to Richard P. Korf (Cornell University) for providing photocopies of his copies of the reprints of the first 8 fascicles.

In order to make the reprint useful for accurate bibliographic citations and to allow location of particular generic treatments, the following lists are provided. For the purposes of this article I have neither attempted to trace pagination of repaged reprints nor have I determined whether they exist in all cases.

Richard Korf (CUP) and Amy Rossman (BPI) read the manuscript before publication and offered useful comments.

SUMMARY OF BIBLIOGRAPHIC INFORMATION

			pages	
Fasc	Journal	Yr	original/	reprint
1	Bull. Soc. Bot. Centre-Ouest	1932	30-46	1-17
2	Bull. Soc. Bot. Centre-Ouest	1933	[21]-36	18-33
3	Bull. Soc. Bot. Centre-Ouest	1934	81-100	34-53
4	Bull. Soc. Bot. Centre-Ouest	1935	100-121	54-75
5	Bull. Soc. Bot. Centre-Ouest	1936	159-176	76-93
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7	Bull. Soc. Bot. Centre-Ouest	1938	62-81	114-133
8	Bull. Soc. Bot. Centre-Ouest	1939	19-37	134-152
9	Revue de Mycologie vol. 7	1942	[3]-26	153-176
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13	Revue de Mycologie vol.10	1945	[96]-116	244-264
14	Revue de Mycologie vol.11	1946	[89]-106	265-282
15	Revue de Mycologie vol.12	1947	[24]-36	283-295
16	Revue de Mycologie vol.12	1947	[45]-68	296-319
17	Revue de Mycologie vol.13	1948	[30]-56	320-346
18	Revue de Mycologie vol.13	1948	[105]-134	347-376
19	Revue de Mycologie vol.14	1949	[26]-57	377-408
20	Revue de Mycologie vol.15	1950	[29]-58	409-438
21	Revue de Mycologie vol.16	1951	[11]-26	439-454
22	Revue de Mycologie vol.16	1951	[80]-100	455-475
23	Revue de Mycologie vol.18	1953	[24]-48	476-500
24	Revue de Mycologie vol.18	1953	[200]-220	501-521
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26	Revue de Mycologie vol.21	1956	[14]-39	551-576
27	Revue de Mycologie vol.21	1956	[146]-173	577-604
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29	Revue de Mycologie vol.22	1957	[166]-182	632-648
30	Revue de Mycologie vol.24	1959	[81]-92	649-660

INDEX TO FASCICLES BY GENUS

25 Abrothallus
3 Acetabula
17 Agyrium
4,5,13 Aleuria
9 Anthracobia
13 Aphanoascus
15 Apostemidium
22 Arachnopeziza
11 Ascobolus
13 Ascodesmis
12 Ascophanus
12 Ascozonus
20 Belonidium
20 Belonium
26 Biatorella
26 Blitrydium
11 Boudiera
28 Briardia
17 Bulgaria
17 Bulgariella
17 Calloria
7 Caloscypha
16 Calycella
26 Catinella
30 Celidium
27 Cenangella
27 Cenangium
9 Cheilymenia
19 Chlorosplenium
18 Ciboria
9 Ciliaria
30 Coccomyces
27 Coccopeziza
10 Coprobia
24 Coronellaria
17 Coryne
17 Corynella
28 Cryptodiscus
29 Cryptomyces
12 Cubonia
15 Cudonia
15 Cudoniella
20 Cyathicula
3 Cyathipodia
11,13 Dasyobolus
20,21 Dasyscypha
27 Dermatea
8 Desmazierella
27 Diplonaevia
4 Discina
17 Discinella
26 Durella
27 Encoelia
24 Ephelina
18 Epiglia
20 Erinella
13 Exoascus
29 Fabraea
5,13 Galactinia
14 Geoglossum
6 Geopyxis
18 Gloeopeziza
27 Godronia
2 Gyromitra
17 Habrostictis
19 Helotium
2 Helvella
25 Heterosphaeria
10 Humaria
11 "Humariaceae," doubtful
18 Hyalinia
22 Hyaloscypha
25 Karschia
8,13 Lachnea
21 Lachnella
18 Lambertella
10,13 Lamprospora
27 Laquearia
13 Lasiobolus
28 Lasiostictis
26 Lecanidion
26 Leciographa
15 Leotia
4 Lepidotia
14 Leptoglossum
3,13 Leptopodia
8 Leucoscypha
3 Macropodia
17 Melachroia
7 Melascypha
26 Melaspilea
9 Melastiza
28 Melittosporium
14 Microglossum
22 Micropodia
1 Mitrophora
14 Mitrula
18 Mniaecia
24 Mollisia
25 Mollisiella
1 Morchella
26 Mycobacidia
26 Mycobilimbia

28 Naevia
9 Neottiella
25 Nesolechia
25 Niptera
28 Ocellaria
28 Odontotrema
16 Ombrophila
17 Orbilia
6 Otidea
16 Pachydisca
6 Pachyella
18 Paryphedria
26 Patellaria
25 Patinella
20 Peristomialis
10 Perrotia
27 Pezicula
7,13 Peziza
29 Phacidium
19 Phialea
28 Phragmonaevia
2 Physomitra
15 Pilacre
24 Pirottaea
22 Pithyella
10 Pithya
25 Placographa
6 Plicaria
27 Pocillum
17 Polydesmia
28 Propolidium
28 Propolina
28 Propolis
10 Pseudombrophila
29 Pseudopeziza
7 Pseudoplectania
6 Pseudotis
2 Ptychoverpa
11 Pulvinula
7 Pustularia
23 Pyrenopeziza
13 Pyronema
4 Rhizina
12 Rhyparobius
30 Rhytisma
11,13 Saccobolus
7 Sarcoscypha
6 Sarcosoma
5 Sarcosphaera
30 Schizothyrium
28 Schizoxylon
27 Scleroderris
18 Sclerotinia
26 Scutula
26 Scutularia
8 Sepultaria
14 Spathularia
11 Sphaeridiobolus
25 Spilopodia
20 Stamnaria
29 Stegia
28 Stictis
18 Stromatinia
25 Tapesia
13 Taphrina
12 Thecotheus
12 Thelebolus
8 Tricharia
14 Trichoglossum
23 Trichopeziza
8 Trichophaea
22 Trichoscypha
27 Trochila
26 Tryblidaria
27 Tympanis
23 Urceolella
7 Urnula
27 Velutaria
2 Verpa
15 Vibrissea
3 Wynnella
28 Xylogramma
28 Xylographa
13 Zukalina

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VERNALLY FRUITING TAXA OF RAMARIA FROM THE PACIFIC NORTHWEST

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Abstract

Several species of *Ramaria* fruit in the spring in the Pacific Northwest. These taxa are reviewed, with a key and commentary. Proposed new names are *Ramaria armeniaca*, *R. magnipes* var. *albidior*, *R. coulterae*, *R. marrii*, *R. thiersii*, and *R. rubricarnata* vars. *verna* and *pallida*.

Among the *Ramaria* taxa which fruit vernally in northwestern North America are several in subgenera *Ramaria* and *Laeticolora*. The spring flora is not limited to members of these subgenera, but representatives of other subgenera [*e.g. R. stricta* (Pers.: Fr.) Quel. of subg. *Lentoramaria* and *R. mutabilis* Pet. of subg. *Echinoramaria*] are fewer, less conspicuous, and have been treated elsewhere (Petersen, 1975, 1981). The purpose of this paper is to outline those vernal fruiters in subgenera *Ramaria* and *Laeticolora* known to us, and to provide a key to help in their identification. It must be stated, however, that we have not seen specimens from the coastal mountains, nor from British Columbia. Additional taxa may be expected, therefore, as inventorying continues. Only small areas can be covered each year, and it seems best now to summarize our investigations up to this time.

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The phenomenology of vernal fruiting in *Ramaria* has not been discussed previously, and cannot be explored in depth here. Although we have collected vernal *Ramaria* specimens on many occasions, we have not been able to assess fruitbody ontogenetic development. Most importantly, we do not know whether fruitbody primordia are in place during the preceding late autumn, awaiting spring rainfall and day length as expansion triggers, or whether such primordia are formed *de novo* in late winter or early spring. At any rate, there is a discernible vernal *Ramaria* flora in the northwest, observable from mid-May through mid-June from the mountains of Idaho through southern Oregon into northern California, north to Alberta and British Columbia. Fruitbodies of several taxa are edible and are enjoyed by mycophagists in that region.

Few definitive relationships between spring-fruiting *Ramaria* taxa and tree species (putative ectomycorrhizal relationships) can be reported. In the northern portion of the sample area, old-stand conifer forests seem most productive, especially (*teste* Marr and Stuntz, 1973) western hemlock [*Tsuga heterophylla* (Raf.) Sarg.] for autumnal fruiters. Over the years, the junior author has found most taxonomic diversity and fruitbody numbers in mature conifer forests including Douglas-fir [*Pseudotsuga menziesii* (Mirbel) Franco], western red cedar (*Thuja plicata* Donn.), white pine (*Pinus monticola* Dougl.) and western hemlock. It would appear that grand fir [*Abies grandis* (Dougl.) Forbes] is the most consistent associate, and perhaps is essential for some spring-fruiting taxa. Spring *Ramaria* fruiting seems most productive above 3000 ft elevation, or in cool, damp pockets below that altitude. In this northern region, *Pinus contorta* Dougl. ex Loud. and *P. ponderosa* Dougl. ex P. & C. Lawson support little or no *Ramaria* fruiting. In the Sierra Nevada mountains of northern California, however, *Ramaria* taxa commonly fruit under *P. ponderosa* and *P. monticola*, with some fruiting over 7000 ft elevation under *Tsuga heterophylla*.

Some of the taxa summarized below also fruit autumnally, apparently, leading to taxonomic problems. The leading publication on *Ramaria* for the area is that by Marr and Stuntz (1973), the revision of a doctoral thesis by Marr (1968). In these, Marr stated that he saw very few vernal specimens, and the specimens he cited confirm this. His taxonomic circumscriptions, therefore, are often restricted to characters of autumnal specimens, and may be too narrow to encompass small differences in vernal fruitbodies. This is especially true, for example, in *R. rubripermanens* and *R. caulifloriformis*. In those cases, we have used the names, but have drawn attention to some discrepant characters. In *R. rubricarnata*, on the other hand, the differences between our vernal material and autumnal specimens (both as described by Marr and collected and annotated by RHP) seem definite enough to propose a new variety for the vernal material. Moreover, dictated by unusual weather conditions in autumn, occasional additional autumnal fruiters are bound to be found in spring, but we can describe only those taxa we have experienced, and the reader is cautioned accordingly.

The vernal flora is quite small compared with the autumnal. Marr (in Marr and Stuntz, 1973) described about 65 taxa in subgenera *Ramaria* and *Laeticolora* from western Washington, but we find less than ten taxa of vernal fruiters. These all have one character in common, to our knowledge: in all cases the stipe of young fruitbodies is large to massive. We assume that two roles can be ascribed to the seemingly wasteful formation of sterile flesh, namely: 1) to act as a moisture reservoir either in the primordial stage or for the expansion of the branches, or both; and 2) to act as a stout base against which the expanding branches can push upward to dislodge the often covering forest leaf litter. Especially in drier climates and conditions, spring *Ramaria* fruitbodies may be found merely "cracking" the humus, with subtle humps on the forest floor the only clue to their whereabouts. This parallels several spring-fruiting agaric taxa. Thus the species with slender, attenuate stipes (*e.g. R. leptoformosa, R. conjunctipes,* etc.) seem absent from the spring flora. Conversely, one might expect some fruitbodies with gelatinous flesh (*e.g. R. gelatinosa* var. *oregonensis*, *R. sandaracina*, etc.) in the spring flora, but such are absent.

In the text below the following abbreviations are used: FSW = ferric sulphate in water; FCL = ferric chloride in water; CRE = l-cresol in water; GUA = guaiac tincture;

GHO = aqueous guaiac solution; PYR = pyrogallic acid in water; PHN = phenol; ANO = aniline oil mixed with water; ANW = alpha naphthol in water; KOH = potassium hydroxide in water; NOH = ammonium hydroxide in water; SYR = syringaldazine in ehtanol; TYR = l-tyrosine in water; IKI = Melzer's reagent; PDAB = p-phenylenediamine. Recipes for these reagents may be found in Marr and Stuntz (1973) and Marr *et al*. (1986). Colors in quotation marks are from Ridgway (1912), while those with alpha-numeric citations are from Kornerup and Wanscher (1967).

Subgenus *Ramaria*

Ramaria rubripermanens Marr & Stuntz. 1973. Biblioth. Mycol. 38: 43.

Fruitbodies (Fig. 1) up to 20 X 10 cm, sphaeropedunculate, circular to broadly ellipsoid in outline. **Stipe** up to 12 X 9 cm, moderate, large, or massive, with clusters of abortive branchlets high on the stipe, white to off-white, not rubescent; flesh white, firm and hard when young, becoming soft to spongy in age, sometimes watery, but not slippery or gelatinous; abortive branch apices concolorous to juvenile apices at all ages. **Major branches** 2-several, ascending but not erect, short and crowded when young, open at maturity, off-white to pale beige. **Branches** in 3-6 ranks, hardly terete, crowded and very short when young, open, long and lax at maturity, white in youth, ivory to fleshy cinnamon by maturity ("cinnamon buff," "pinkish buff," "pale ochraceous salmon," "light buff"); axils rounded, often split in age; internodes elongating acropetally, diminishing gradually at maturity. **Apices** crowded, spinulose, from pale pink or pallid pink ("pale salmon color," "light pinkish cinnamon," "pinkish buff," "seashell pink," "light vinaceous cinnamon," "flesh color") to buffy red or blood red ("garnet brown," "deep Corinthian red," "Pompeian red," "acajou red," "ocher red"), especially where protected or in youth, expanding to pluridentate at maturity, fading significantly over time to dull rosy pink ("buff pink," "light vinaceous cinnamon," "Japan rose"), color persisting after picking. **Odor** very weakly fragrant, often strong of fenugreek when dried; **taste** negligible when fresh or very weak of vegetables; edible and choice.

Macrochemical reactions: FSW, FCL = positive; IKI = slowly, deep purple-brown or violet-brown, often tardy; PYR

= equivocal; ANW, ANO, GUA, PHN, KOH, NOH, PDAB = negative.

Stipe tramal hyphae 5-25 µm diam, hyaline, clamped, thick-walled (wall up to 1.5 µm thick, undulate), interwoven, not agglutinated or adherent; ampulliform clamps up to 16 µm broad, locally thick-walled (wall up to 1 µm thick), with local stalactitiform ornamentation; gloeoplerous hyphae occasional, as short, undelimited, undifferentiated, refringent lengths juxtaposed to septa. Tramal hyphae of upper branches 4-20 µm diam, hyaline, clamped, thin- to thick-walled (wall locally up to 0.5 µm thick), parallel, not agglutinated or adherent; ampulliform inflations and gloeoplerous hyphae not observed. Hymenium thickening; **basidia** 40-80 X 8-11 µm, clavate, clamped; contents minutely multiguttulate; sterigmata 4, rather stout, straight.

Spores (Fig. 2) 10.4-15.5 X 4.0-5.0 µm (E = 2.14-3.08; Em = 2.58; Lm = 12.17 µm), ellipsoid to subboletoid, very subtly undulate in profile; contents 1-several guttulate, the guttules dark yellow, refringent; wall up to 0.2 µm thick; hilar appendix not prominent, subpapillate; ornamentation of prominent cyanophilous striae in a generally distal-abaxial to proximal-adaxial configuration.

Commentary: Vernal fruitbodies vary widely in intensity and durability of apex color. In many cases (commonly called *R. rubripermanens*), the color is ruddy to dull rosy maroon, while in others (commonly called *R. rubrievanescens*) only a blush of pink or mauve can be seen, disappearing as fruitbodies mature. All spring collections, however, agree on non-rufescent stipe surfaces.

Of the four collections of *R. rubripermanens* cited by Marr and Stuntz (1973), two were vernal (June) and two were autumnal (September, October). Moreover, the type specimen was vernal. An analysis of the type specimen (SUCO, Marr no. 581!) and published material result in development of the following diagnosis for the species: 1) abortive branchlets and young apices pallid pink, fading little through ontogenetic development; 2) massive stipe with few abortive branchlets; 3) unstaining stipe surfaces; 4) strongly reactive stipe flesh in IKI; and 5) strongly striate spores.

Careful examination of the type specimen of *R. rubrievanescens* (SUCO, Marr. no. 584!), together with

Marr's auxiliary collections and published material, establish the following criteria for the taxon: 1) abortive branchlets and young apices pink to peach, with the color lost easily during ontogenetic development or after deprivation of mycelial water; 2) massive stipe with a few abortive branchlets; 3) rufescent staining on stipe surfaces; 4) strongly reactive stipe flesh in IKI; and 5) strongly striate spores. In addition, all of Marr's specimens were autumnal. Thus, *R. rubripermanens* was thought to differ on two characers from *R. rubrievanescens*: 1) longer duration of pink coloration; and 2) unstaining stipe surfaces. Furthermore, there was no evidence that *R. rubrievanescens* fruited vernally.

Apex color cited for *R. rubripermanens* by Marr and Stuntz (1973: 8-9A,B2-3) is considerably paler than the folkloristic concept of the taxon. Indeed, of the collections cited by Marr and Stuntz, one (RHP 1708, now TENN no. 36720) showed apices of dull red ("ocher red") fading toward maturity to fleshy pink ("onion-skin pink"). Fruitbodies of two other collections made within a few days of TENN 36720, and annotated by Marr as *R. rubripermanens* (TENN 36721, 36716) exhibited even darker apices ("Etruscan red" when young, "light Jasper red" to "carrot red" in adolescence, and "flesh ocher" at maturity. Thus, color of abortive branchets and apices can vary from pallid or pale pink through various shades of dull red to dull fleshy maroon. Nonetheless, the unstaining stipe surfaces seem constant.

It seems best, then, to allow the range of color acceptable under the name *R. rubripermanens* to broaden, but to persist in requiring non-staining stipe surfaces. The result, to our knowledge, is that *R. rubripermanens* is rather variable in color, and fruits vernally and autumnally, while *R. rubrievanescens* is always pink to pallid pink over apices, always shows rufescent stipe surfaces, and apparently fruits only autumnally.

Marr (in Marr and Stuntz, 1973) considered an amyloid reactions in this group to include "violet to deep violet color." Our observations indicate a consistent brown component, so the reaction could be described as violet-brown to dark purple-brown, with speed and intensity variable. But in the *R. magnipes* - *R. rasilispora* complex the reaction is gray-blue to blue with mottling of green and yellow shades. The two reactions must be distinguished, therefore, and we prefer to call the reaction in subg. *Ramaria* strongly dextrinoid, in order to conform with common usage of the term.

Apparently there is a pattern of amyloid tissue in the stipe. Parallel transverse streaks of Melzer's reagent from the bases of major branches to the stipe base across longitudinally sectioned fruitbody flesh show that dextrinoid tissue occurs high at the periphery of the stipe, progressing inwardly downward in the stipe. Finally, at the stipe base, the entire diameter of the tissue is dextrinoid. In short, the dextrinoid tissue is bowl-shaped.

Spore length in some striate-spored taxa is quite variable. In this species, it extends to 17 µm or more, and often this is coupled with a slight reduction in spore width. The taxonomist must judge at which length he must stop using spores for statistical purposes. We conclude that Marr was somewhat conservative, perhaps accounting for his report of Lm = 11.7 µm. At the same time, of course, some of his material was autumnal, while the dimensions above were taken from vernal specimens only.

Spore ornamentation is often bidirectional: distally longitudinal, proximally diagonal as described. Such a configuration is common in subg. *Ramaria*.

North-central Oregon specimens differ from northern Idaho material in the following ways: 1) presence of a few abortive stumps high on the stipe; 2) very local, weak brunnescence of stipe surfaces; and 3) strong, instantaneous positively dextrinoid reaction of stipe flesh.

In juvenile material, branches are so short, and apices so stiff that the fruitbodies look spiny. This condition apparently persists for considerable time periods, for only very mature fruitbodies are found with elongated branches. It is this juvenile stage which is considered the choicest edible in the *Ramaria* flora. When fried, fruitbodies have a fine, mildly nutty flavor.

It may be difficult to separate mature (or over-mature) specimens of *R. rubrievanescens* from specimens of Marr's concept of *R. strasseri*. The latter was characterized (by Marr) as follows: "(1) pale yellow to light tan fruiting bodies, (2) sweet, spicy aroma, (3) type and other European specimens, *R. strasseri* seems to produce pinkish beige to cinnamon tan fruitbodies with somewhat violaceous apices, so Marr's inclusion of pale yellow fruitbodies may be too permissive. At any rate, his concept of *R. strasseri* is separable from *R. rubripermanens* by spore length, fruitbody odor and strength of the IKI reaction on stipe flesh.

Similar to *R. rubripermanens* is *R. eryuanensis* Petersen and Zang (*nom. prov.*) from northern Yunnan Province, China. It shares all major characters, but shows hints of pink or mauve on the lower stipe, and produces slightly smaller spores (10.8-13.0 X 4-5 µm; E^m 2.65; L^m 11.88 µm).

The specimens listed below are separated into those with pale or pallid pink apices, originally thought to be *R. rubrievanescens*, and those whose apices were some shade of dull red to dull maroon, originally identified as *R. rubripermanens*.

Specimens examined (as *R. rubripermanens*): Idaho: Kootenai Co., 7.vi.84, no. 45911 (TENN); Kootenai Co., vic. Spirit Lake, 24.vi.71, Scates nos. 1556, 1557, no. 47621 (TENN); same location, 3.vi.70, Scates no. 558, no. 47582 (TENN); Kootenai Co., E. Hayden Creek, 4.vi.74, Scates no. 3081, no. 47620 (TENN); Kootenai Co., Farragut State Park, 29.v.72, Scates no. 1882, no. 47583 (TENN); Kootenai Co., Canfield Mt., 21.vi.70, Scates no. 634, no. 47614 (TENN); Kootenai Co., Bayview, 30.v.72, Scates no. 1881, no. 47591 (TENN); Oregon: Morrow Co., Cutsforth County Park, 15.vi.85, coll. RHP and M. Rogers, no. 46683 (TENN).

Specimens examined (as *R. rubrievanescens*): Idaho: Bonner Co., Upper Priest Lake, 28.vi.72, Scates no. 1942, no. 47572 (TENN); Kootenai Co., Spirit Lake, 26.vi.76, coll. K. Scates, no. 45759 (TENN); Kootenai Co., Farragut State Park, 27.vi.76, coll. Ernie Wells, no. 45773 (TENN); Kootenai Co., Farragut Rifle Range, 26.vi.76, coll. K. Scates, no. 45770 (TENN); Kootenai Co., Farragut State Park, 3.vi.70, Scates, no. 565 no. 46650 (TENN); Kootenai Co., vic. Hayden Creek, 7.vi.70, Scates no. 582, no. 46648 (TENN); Kootenai Co., vic. Spirit Lake, 1.vi.71, Scates no. 1422, no. 47574 (TENN); same location, 27.v.78, Scates no. 4923, no. 46571 (TENN); Kootenai Co., vic. Bumblebee, 23.v.71, Scates no. 1394, no. 47596 (TENN); Kootenai Co., Hayden Creek, 7.vi.70, Scates no. 3103, no. 47578 (TENN); Kootenai Co., Lost Loggers' Maze, 19.vi.71, Scates no. 1549, no. 47575 (TENN). Oregon: Jefferson Co., Deschutes Nat. For., Suttle Lake Rd., 18.vi.85, no. 56131 (TENN); Morrow Co., Cutsforth County Park, 15.vi.85, coll. RHP & M. Rogers, no. 56126 (TENN). Washington: Lake Kachess State Park, 10.vi.74, Scates no. 3101, no. 47597 (TENN).

Subgenus *Laeticolora*

Key to western, vernal taxa of subg. *Laeticolora*

1. Basidia without clamp connections. 2

1. Basidia with clamp connections 4

  2. Fruitbodies cinnamon tan to light chocolate brown; spores obscurely roughened . . . . *R. marrii*

  2. Fruitbodies not tan or brown 3

3. Young apices fleshy buff to dull red, fading to fleshy pink, with very tips often brown where exposed or bruised; ranches ivory to flesh-buff . . .*R. coulterae*

3. Branches and apices orange to bright apricot; stipe flesh white, homogeneous; spores 8.6-11.5 (12.6) X 3.6-4.3 µm; northern Idaho . . . .*R. armeniaca*

  4. Spores smooth at 1000X 5

  4. Spores rough at 1000X. 8

5. Stipe surface weakly brunnescent; stipe massive, usually with abortive branchlets 6

5. Stipe surface not brunnescent; stipe large to massive; apices usually knobby, dilated 7

  6. Branches white to very pale yellow; apices greenish yellow, often with blush of pink where exposed; stipe massive, white, with abortive stumps; hymenium not reactive (except in iron salts); northern California . . . . *R. magnipes* var. *albidior*

  6. Branches light clear yellow when young; apices bright yellow to chartreuse yellow, often pallid rosy pink where exposed; spores 9.4-13.3 X 3.2-5.0 µm (*Lm* = 11.5 µm). . . . . *R. magnipes* [var. *magnipes*]

7. Branches buffy yellow, pale ochraceous yellow to fleshy buff when young; apices pastel chartreuse yellow; spores 8.3-11.5 X 3.6-4.3 µm (*Lm* = 9.95 µm). . . . . *R. rasilispora* var. *rasilispora*

7. Branches ochraceous cream colored; apices pastel greenish yellow when young; spores 9.4-11.9 X 3.2-4.3 µm (*Lm* = 10.6 µm). . . .*R. rasilispora* var. *scatesiana*

8. Branch sections positive in FCL, PYR, ANO, GUA . . . 9

8. Branch sections not macrochemically reactive (except FCL); stipe base rubescent; branches and branch flesh pale yellow; spores 11.2-14.0 X 4.3-5.0 µm (*Lm* = 12.4 µm). . . . . *R. vinosimaculans*

9. Branches and apices buffy cinnamon to fleshy tan; apices often discolored to brown; hymenium slowly brownish where cut; stipe flesh brittle, IKI negative; branch sections positive in FCL, PYR, ANO, GUA. . . . . *R. caulifloriformis*

9. Branches light yellow, often with pale salmon tint; apices yellow; hymenium brunnescent or not; branch sections macrochemically reactive or not 10

10. Branches cream color to light salmon; branch flesh bright to pallid salmon; spores 10.4-12.2 µm long (*Lm* = <11.5 µm); IKI weakly positive; SYR reaction slow. 11

10. Branches dull pale yellow-ochre; apices clear yellow; spores 12-15 µm long (*Lm* = 13.5 µm); often under humus in gritty soil; stipe flesh IKI negative; SYR reaction rapid . . . . *R. thiersii*

11. Spore L^m ca. 10 µm; branches pallid cream to salmon yellow; apices pale to light yellow . . . . *R. rubricarnata* [var. *rubricarnata*]

11. Spore L^m = >11 µm; branches as above or more pallid..12

12. Branches salmon to salmon-yellow; branch flesh bright salmon; branches short, stocky . . . . *R. rubricarnata* var. *verna*

12. Branches cream-colored to pinkish buff; branch flesh muted pinkish buff; branches elongate. . . . . *R. rubricarnata* var. *pallida*

1. ***Ramaria armeniaca*** Petersen & Scates, *sp. nov.*

Basidiocarpi multiramosi, ad 12 X 8 cm, subglobosi ad crassi-obovati. Basi ad 4 X 6 cm, crassi, singulati, sine ramuli abortivi, contusi non-brunnescenti. Rami et ramuli pallido-aurantii ad aurantii; apices crassi, aurantii. Hyphae contextualis afibulatae, tenuitunicatae; basidia 50-70 X 7-9 µm, clavata. Sporae 8.6-11.5 X 3.6-4.3 µm, tenui-ellipsoidae, laevis vel sublaevis.

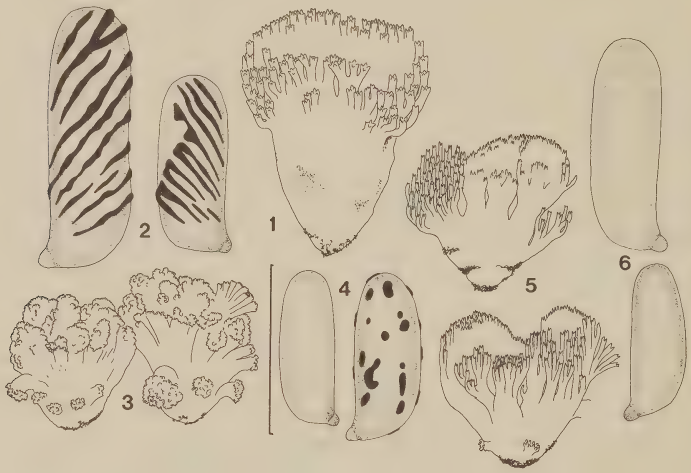
Fruitbodies up to 12 X 8 cm, subcircular to broadly obovate in outline. **Stipe** up to 4 X 6 cm, large to massive, single, smooth, usually without abortive branchlets, broadly tapering to a point, white to off-white, unchanging on handling or bruising; flesh white, watery but not slippery, with no sign of brown patch or band, drying light, firm, easily penetrated. **Major branches** 3-several, hardly terete, off-white below, shading to orange above. **Branches** in 2-4 ranks, terete, pallid pastel orange below, pallid orange to melon color (5-6A5-7) above; flesh white, firm, drying light, friable; internode length diminishing gradually upward at maturity; axils lunate below, narrowly rounded above. **Apices** coarse, crowded when young, bluntly, minutely knobby at maturity, orange to deep orange (6A7, 7A7). **Odor** negligible; **taste** mild.

Macrochemical reactions: FCL = stipe flesh negative, branch sections slowly positive; ANO, ANW, GUA, PHN, PYR, PDAB, KOH, NOH = negative.

Tramal hyphae of upper branches 4-15 µm diam, thin-walled, clampless, hyaline, parallel, not adherent. Subhymenium rudimentary. Hymenium thickening; **basidia** 50-70 X 7-9 µm, clavate, clampless; contents multiguttulate at maturity; sterigmata 4, spindly, peripheral.

Spores 8.6-11.5 (12.6) X 3.6-4.3 µm (E = 2.36-2.91; Em = 2.65; Lm= 10.25 µm), narrowly ellipsoid to subcylindrical, obscurely undulate in profile; contents uninucleate, 1-3-guttulate, the guttules dark yellow, refringent; wall up to 0.3 µm thick; hilar appendix small, inconspicuous; ornamentation none or merely a suggestion of very low warts.

Commentary: Fruitbodies of *R. armeniaca* are brightly colored, ranging from pastel orange to bright orange. This, together with coarse apices, clampless condition and homogeneous white stipe flesh, will serve to separate the species easily in the spring flora.



Figs. 1-6. Fruitbodies and basidiospores of *Ramaria* taxa. 1, 2. *R. rubrievanescens*. 1. Fruitbody. From photo of holotype. 2. Spores. TENN 45759. 3, 4. *R. coulterae*. 3. Fruitbodies. TENN 45711. 4. Spores. Scates no. 575. 5, 6. *R. armeniaca* 5. Fruitbodies. TENN 46687. 6. Spores. Holotype. Standard bar = 10 µm for spores. Fruitbodies not to scale.

Superficially, fruitbodies of *R. armeniaca* look like those of *R. gelatiniaurantia* Marr and Stuntz, but that species fruits in autumn, and flesh of the stipe and lower branches is evidently gelatinous.

To this time, *R. armeniaca* seems limited to northern Idaho, but its formal description may solicit additional collections from elsewhere. Because so few identified collections are known, no authoritative report on edibility can be given.

Specimens examined: Idaho; Kootenai Co., East Hayden Creek, 15.vi.70, Scates no. 615, TENN no. 46652, (holotype, TENN); Kootenai Co., location unknown, 22.vi.73, coll. L. Chariton, Scates no. 2588, no. 46781 (TENN); Kootenai Co., Back Door Hill, 4.vi.85, coll. KS and H. Barnhart, Scates no. 7016, no. 46780 (TENN); Kootenai Co., Hayden Lake Rimrock, 12.vi.71, coll. F. Heard, Scates no. 1517 (TENN); same location, 19.vi.71, Scates no. 1551 (TENN).

2. *Ramaria caulifloriformis* (Leathers) Corner. 1970. Beih. Nova Hedwigia 33: 268.

≡ *Clavaria caulifloriformis* Leathers. 1956. Mycologia 48: 278.

= *Ramaria cartilaginea* Marr and Stuntz. 1973. Biblioth. Mycol. 36: 59.

Fruitbodies up to 16 X 15 cm, circular to sphaeropedunculate in outline. **Stipe** up to 4 X 5 cm, single to falsely fasciculate, mycelial at base, rounded, involving copious substrate when picked, tomentose between substrate fragments, off-white where protected, with numerous abortive branchlets and clusters, especially high on stipe, hardly brunnescent; flesh white to off-white, solid to heterogeneous, moist but not slippery or soapy, not hygrophanous, not showing a brown band or patch. **Major branches** numerous, crowded, hardly terete, pale pallid buff ("ochraceous buff," "pale pinkish cinnamon"); flesh white, solid. **Branches** in 3-6 ranks, lobed in section, pallid buff to pallid pinkish buff ("pinkish buff," "ochraceous buff," between "light ochraceous buff" and "light buff"); flesh "pale ochraceous buff;" internode length diminishing upward gradually at maturity; axils rounded. **Apices** double-dichotomous when young, becoming cusped or knobby by maturity, pallid pinkish buff ("pinkish buff," "cinnamon buff"), often turning dark brown ("warm sepia") where exposed or dried in the field. All upper parts slowly "cinnamon" in age, sometime reluctantly vinescent. **Odor** negligible to mildly fabaceous or weakly agaricoid; **taste** negligible to faintly fabaceous or tardily musty; flesh crisp to crunchy when chewed; edible.

Macrochemical reactions: ANW, ANO, GUA, PYR, PHN, FCL = positive; SYR = quickly positive; KOH = browning on hymenium; IKI = equivocal on stipe flesh and branch sections; TYR, CRE = negative.

Stipe tramal hyphae 3-10 µm diam, hyaline, refringent, occasionally clamped, thick-walled (wall often obscuring cell lumen), interwoven, not agglutinated or adherent; gloeoplerous hyphae and ampulliform clamps not observed. Tramal hyphae of upper branches 3-9 µm diam, hyaline, thin- to thick-walled (wall up to 0.5 µm thick), clamped, strictly parallel, often sinuous, sometimes adherent but not agglutinated; gloeoplerous hyphae hardly visible under phase contrast, strongly cyanophilous, often with aliiform swellings, occasionally branched; cyanophilous deposits common, amorphous to roughly spherical; ampulliform clamps not observed. Subhymenium extensive; hyphae 2-2.5 µm diam, very tightly interwoven, clamped, hyaline. Hymenium thickening; **basidia** 45-60 X 7-8.5 µm clavate, clamped, multiguttulate to multigranular at maturity, strongly cyanophilous; sterigmata 4, straight, spindly.

Spores 8.3-10.4 X 4.7-5.8 µm (E = 1.64-2.15; E^m = 1.82; L^m = 9.33 µm), short-cylindrical to broadly ellipsoid, distinctly roughened in profile; contents deep yellow, usually multigranular or with 2-4 amorphous, hardly refringent guttules; wall up to 0.2 µm thick; hilar appendix gradual; struma evident; ornamentation of small warts, mostly discrete, some lobed in outline.

Commentary: Marr and Stuntz (1973) drew attention to the possible similarity between their *R. cartilaginea* and *R. caulifloriformis*. Their description of *R. cartilaginea* included, however, distinctly yellow shades (4A3-4, Kornerup and Wanscher, 1967) on lower fruitbody surfaces (stipe and underground portions), and somewhat yellower colors (4-5A4-5, young branches and apices; 5B4-7, mature upper parts) on exposed fruitbody surfaces. Nonetheless, my experience with *R. cartilaginea* indicates colors closer to those described by Leathers for *C. caulifloriformis*.

In sharing all the above characters, together with thick-walled, agglutinated stipe tramal hyphae and very similar spore ornamentation, the only difference between *R. cartilaginea* and *R. caulifloriformis* is the congested, connate upper branches of one fruitbody (not all) of the type specimen of *R. caulifloriformis*, even though the tendency is also present in some specimens of *R. cartilaginea* (although not in the type specimen). I conclude that *R. caulifloriformis* in an older epithet which should be used in place of *R. cartilaginea*.

The type specimen of *R. caulifloriformis* was collected on 1.ix.51 (no. 319. MICH!), and must be considered autumnal. This, and natural variation over a wide geographic range, may account for the slight differences in color furnished by Leathers (1955, 1956), Marr and Stuntz (1973), and above. "Disjunct" distribution from the Pacific Northwest to northern Michigan (Topinabee is a few kms south of the Straits of Mackanack) is not unheard of, but may represent a portion of an even wider distribution pattern.

Petersen (1985), in his description of *R. maculospora*, compared it with *R. cartilaginea*, concluding that spore ornamentation was different, as was fruitbody coloration. The first observation was correct, for although spore statistics are very similar (for *R. maculospora*, E = 1.64-2.08; E^m = 1.79; L^m = 8.95 μm), spore ornamentation in *R. maculospora* shows no lobed warts, but only discrete spots when stained in aniline blue.

To this time, only two vernal specimens of *R. cauliflориformis* have been collected, both from the Sierra Nevada of California. The taxon may be a sporadic, coincidental fruiter.

Diagnostic characters for the species are: 1) presence of clamp connections; 2) short, wide spores; 3) large stipe with abortive branchlets; and 4) pinkish buff coloration.

Vernal specimens examined: California, Sierra Co., Tahoe Nat. Forest, 9.vi.86, coll. H.D. Thiers, no. 46999 (TENN); same location, 11.vi.86, no. 46994 (TENN).

Autumnal specimens examined: Idaho: Bonner Co., Priest Lake, Beaver Creek, 30.ix.84, coll. K. Scates, no. 45918 (TENN); Kootenai Co., Fourth of July Ravine, 1.x.84, coll. K. Scates and A. Methven, no. 45906 (TENN). Oregon: Mt. Hood Nat. Forest, vic. Government Camp, 17.x.84, coll. K. Scates and T. Pearson, no. 45855 (TENN); location unknown, Puget Sound Mycol. Soc. show, 13.x.84, no. 45894 (TENN).

3. ***Ramaria coulterae*** Scates, *sp. nov.*

Basidiocarpi multiramosi, ad 12 X 10 cm, crassi-obpyriformi ad subglobosi. Basi ad 8 X 6 cm, immensi, singulati, cum ramuli abortivi, albi vel cremei, laevi, contusi tarde brunnescenti. Rami et ramuli pallide bubalini. Apices caulifloriformi, bubalino-incarnati. Hyphae contextualae afibulatae, crassitunicatae; basidia 50-70 X 8-9 μm, clavata, afibulata; sterigmata 4. Sporae 8.3-10.1 X 3.2-4.0 μm, tenui-ellipsoideae ad cylindricae, laevae vel obscure subcorrugatae.

Fruitbodies (Fig. 3) up to 12 X 10 cm, broadly obpyriform to subcircular in outline. **Stipe** up to 8 X 6 cm, large to massive, single, deeply lined or channelled, smooth or with very blunt abortive processes or branchlets, white to off-white, smooth, not pruinose or tomentose, slowly brunnescent to pallid purple-gray ("Quaker drab," 11D2) where handled or bruised; flesh watery but not slippery or gelatinous, off-white, usually with brownish, fan-shaped area when cut longitudinally. **Major branches** 3-several, very short when young, hardly terete, white to ivory colored. **Branches** in 3-6 ranks, very short when young, off-white, pale yellow (3A3-4) to very pale beige ("pale pinkish cinnamon," "pale ochraceous salmon"), darkening to buffy flesh ("pinkish buff," "light ochraceous salmon") in age; flesh very brittle, crisp, white upward, in lower branches stringy, fibrous, ripping longitudinally; internodes all short when young; axils acute when young. **Apices** very crowded, cauliflower-like, and stiff when young, often expanding to knobby in age, at all ages with 4-6 crests at each apex, minutely pluridentate, deep dull fleshy red ("Indian red," "ocher red") to fleshy beige ("pinkish buff," "cinnamon buff") when young, quickly fading to fleshy pink ("light vinaceous cinnamon," 8B3) in adolescence, in age concolorous with major branches, at all ages with very tips brown ("Hay's russet," "Verona brown") to dark brown ("carob brown," "bister"). **Odor** negligible; **taste** mildly nutty; probably edible and good.

Macrochemical reactions: FSW = weakly positive; ANO, ANW, PYR, PHN, GUA, KOH, NOH, IKI, PDAB = negative.

Stipe tramal hyphae 4-13 µm diam, hyaline, clampless, thick-walled (wall up to 1 µm thick), tightly interwoven, not agglutinated or adherent; ampulliform inflations up to 15 µm broad, aliiform, thick-walled (wall locally up to 1.5 µm thick), with extensive and coarse stalactitiform ornamention; gloeoplerous hyphae occasional, 4-15 µm diam, thin-walled, yellow-refrigent. Tramal hyphae of upper branches 4-14 µm diam, hyaline, clampless, thin- to thick-walled (wall up to 0.5 µm thick), parallel, free to adherent; ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium extensive. Hymenium thickening; **basidia** 50-70 X 7-9 µm, clavate, clampless; contents minutely multiguttulate when mature; sterigmata 4, stout, straight.

Spores (Fig. 4) 8.3-12.6 X 2.9-4.0 µm (E = 2.50-3.96;

Em = 2.81; *Lm* = 9.95 μm), narrowly ellipsoid to cylindrical, smooth to obscurely undulate in profile; contents uninucleate, homogeneous to 1-2-guttulate, the guttules dark yellow, refringent; wall up to 0.2 μm thick; hilar appendix small, gradual; ornamentation none or a few ill-defined small, low warts.

Commentary: *Ramaria armeniaca*, *R. coulterae* and *R. marrii* are the clampless vernal fruiters we have encountered. In general aspect *R. coulterae* closely resembles certain forms of *R. celerivirescens* Marr and Stuntz, which also exhibits the brown patch of stipe flesh, but the flesh of which instantly turns deep green in FSW. I know of two other similar taxa with brownish stipe flesh which do not show the instantaneous color change in ferric salts, but hyphae of both are clamped, neither has been described, and both are autumnal fruiters. Finally, *R. flavo-brunnescens* var. *aromatica* Marr and Stuntz seems always to show a yellow-brown diffuse patch of flesh at the stipe base, but its hyphae also are clamped and its fruiting time autumnal.

When fresh, some fruitbodies of *R. coulterae* with dark red apices were so similar to those of *R. rubripermanens* that the specimens were assumed to belong to that complex in subg. *Ramaria*. Vinaceous pink apices, buffy branches and massive stipe all pointed in that direction. Negative reaction of stipe flesh with IKI, however, cautioned against quick taxonomic judgment. Subsequently, micromorphology dictated placement in subg. *Laeticolora*, where the fruitbodies matched *R. coulterae* in all other respects. Because of the easy confusion with *R. rubripermanens*, we assume that *R. coulterae* is eaten along with *R. rubripermanens*, and must be considered edible.

Distribution os *R. coulterae* seems confined to the intermountain area from northern and west-central Idaho to north-central Oregon, into the Sierra Nevada of California. The sole Oregon station is at the foot of the Peters Butte extension of the Blue Mountains, a moister area than generally found in that region.

The species is named in honor of Ms. Elsie Coulter, longtime collector and mycological enthusiast in northern Idaho, and 20-year collecting companion of the junior author.

Specimens examined: California: Sierra Co., Tahoe Nat. Forest, 11.vi.86, coll. Travis Dinoff, no. 47016 (TENN). Idaho: Kootenai Co., vic. Hayden Lake, 7.vi.84, no. 45771 (holotype; TENN); Kootenai Co., vic. Spirit Lake, 6.vi.70, coll. KS, Scates no. K575, no. 46654 (TENN); Kootenai Co., Hoodoo Creek, 7.vi.80, coll. KS, Scates no. 5941, No. 46782 (TENN); Kootenai Co., Hayden Lake, 27.v.80, Scates no. 5814, no. 47570 (TENN); Kootenai Co., Hayden Lake, 11.vi.70, Scates no. 606, no. 47550 (TENN); Valley Co., vic. McCall, public ski area on Rt. 55, 24.vi.78, Scates no. 4959, no. 46783 (TENN). Oregon: Morrow Co., Cutsforth County Park, vic. campground, 15.vi.85, coll. RHP and M. Rogers, no. 46687 (TENN).

4. *Ramaria magnipes* Marr & Stuntz. 1973. Biblioth. Mycol. 38: 105.

Fruitbodies (Fig. 9) up to 15 X 18 cm, circular to depressed ellipsoid in outline, often only semi-emergent above substrate. **Stipe** up to 8 X 8 cm, large to massive, single, rounded at base, covered with sandy to gritty soil, smooth, here and there tomentose between substrate particles, sometimes with clusters of abortive branches and branchlets, white to off-white, often weakly brunnescent to neutral brown ("Saccardo's umber," "snuff brown"); abortive branch systems cauliflower-like, white where protected; flesh solid, white, homogeneous to mottled, occasionally in a fan-shaped pattern, drying hard. **Major branches** 2-4, up to 2.5 cm thick, short when young, lengthening significantly, more or less terete. **Branches** in 3-5 ranks, hardly terete, usually crowded, light yellow to pastel greenish yellow ("maize yellow," "antimony yellow," "pinard yellow," "Naples yellow," "mustard yellow"), slowly mellowing to light pallid salmon or fleshy buff ("light ochraceous buff," "light ochraceous salmon"), in age pallid fleshy ochre to fleshy tan ("ochraceous buff," "light ochraceous buff," "ochraceous tawny"); flesh white below, very pale cream color ("pale pinkish cinnamon") upward; internodes lengthening acropetally, diminishing upward abruptly at maturity; axils narrowly rounded to acute. **Apices** cauliflower-like when young, crowded, somewhat terraced when young, cuspidate to molar-like and coarse by adolescence, remaining so in age, white where protected, where exposed bright yellow to intense chartreuse yellow ("straw yellow," "Naples yellow," "mustard yellow," "wax yellow," "strontium yellow," "baryta yellow," "pinard yellow," "antimony yellow," "apricot yellow"), mellowing in age to buff-colored ("ochraceous buff," "light ochraceous buff," "warm buff"), often changing to brick red ("brick red," "russet," "tawny," 8D6) when crushed, bruised or exposed to frost, in age usually inflating to irregularly pistillariform shapes. **Odor** negligible, weakly aromatic or fabaceous; **taste** weakly fabaceous, weakly bitter or weakly agaricoid; edible, widely eaten.

Macrochemical reactions: FCL, FSW = positive; IKI = slowly, weakly positive; GUA, PYR, ANO, ANW, PHN, KOH, NOH, PDAB = negative.

Stipe tramal hyphae 6-20 µm diam, hyaline, clamped, not agglutinated or adherent, thin- to thick-walled (wall up to 0.5 µm thick), tightly interwoven; ampulliform inflations up to 25 µm broad, usually thin-walled, occasionally thick-walled (wall up to 0.5 µm thick), with extensive, delicate stalactitiform ornamentation or unornamented; gloeoplerous hyphae not observed. Tramal hyphae of upper branches 5-14 µm diam, hyaline, clamped, free to locally adherent, thin- to thick-walled (wall up to 1 µm thick, often undulate), more or less parallel; clamp connections often abrupt and distorted; ampulliform inflations rare, up to 13 µm broad, asymmetrical, not usually thick-walled, unornamented; gloeoplerous hyphae rare, 2.5-3.5 µm diam, refringent, tortuous, abruptly inflated here and there. Subhymenium rudimentary. Hymenium thickening; **basidia** 50-65 X 7-8 µm, clavate, clamped; contents homogeneous; sterigmata 4, spindly, straight.

Spores (Fig. 10) 9.4-13.3 X 3.2-5.0 µm (E = 2.29-3.50; Em = 2.89; Lm = 11.51 µm), cylindrical to narrowly ellipsoid (and then flattened adaxially), smooth; contents several-guttulate, the guttules amorphous, dark, non-refringent; hilar appendix small, gradual; ornamentation none or a few slender, meandering ridges.

Commentary: Marr (in Marr and Stuntz, 1973) stated that *R. magnipes* and *R. rasilispora* (both varieties) differed in the following ways (respectively): 1) more intense coloration versus less intense; 2) longer versus shorter spores; 3) more massive stipe versus less so; and 4) bitterness when cooked versus (presumably) no bitterness when cooked. Careful analysis of the characters described here will confirm 1), 2) and 3), but I have no data on 4). Of those taxa whose fruitbodies are eaten in the area, *R. magnipes* is one of the most popular because fruitbodies are common, and, at least when juvenile, of firm consistency. Although a few reports of gastric distress have been heard, these are exceptions, not the rule. Fruitbodies of *R. rubripermanens* and *R. vinosimaculans* are tastier and more highly prized than those of any other spring fruiter, but those of yellow *Ramaria* taxa are sometimes used dried or pickled.

Ramaria magnipes and *R. rasilispora* seem very similar, even in the field. They share yellow to greenish yellow coloration, presence of clamp connections and smooth spores, the last isolating them from the vast majority of taxa in subg. *Laeticolora*.

Fruitbodies often expand at or beneath the humus layer in coniferous forests, only cracking the substrate surface. With a massive stipe acting as a moisture reservoir and solid base, branches expand and lengthen upward. Apices are coarse and cuspidate, able to withstand substrate weight and resistance as fruitbody expansion pushes them through the humus. Because the stipe is embedded in the soil beneath the humus, it is usually covered with grit when picked, and herbarium specimens often exhibit more grit-covered stipe than branches.

Pigmentation seems photo-induced, for protected branches and apices are white, while on the same fruitbody branch systems exposed to the light are yellow. Dried specimens assume a hard, woody consistency, with drab ochre color over the branches and dark dull orange-brown apices. Dried stipes darken noticeably, with cut surfaces golden brown. Dried specimens of *R. rasilispora* are lighter in color and density. Branches of dried fruitbodies of *R. magnipes* show considerable shriveling, while those of *R. rasilispora* tend to retain their original shape.

In *R. magnipes*, tramal hyphae of uppers branches are locally and occasionally extensively adherent. Although we have not examined many specimens for this character, we find that upper branch tramal hyphae of *R. rasilispora* are not so. While this seems subtle when spore size and fruitbody coloration are available for separation, specimens are often nearly sterile (especially when almost covered by humus layer) and in the virtual absence of spores, and in dried specimens, it may provide a clue to identity.

Stipe flesh of *R. magnipes* and *R. rasilispora* reacts positively to Melzer's reagent, slowly changing to deep blue-green with yellow tints, not unlike the bruising reaction of humans called "black and blue." This reaction is similar to the microscopic amyloid reaction of spores and other structures. Conversely, it is very different from the deep purple-brown reaction of stipe flesh of *R. rubripermanens*. (*q.v.*). Marr (in Marr and Stuntz, 1973) indicated only a "dull violet or deep violet" reaction as positive, and under *R. magnipes* and *R. rasilispora* recounted the reaction as "weakly amyloid, the reaction slow, requiring about 1 1/2 hrs." Thus it is difficult to interpret the reaction of the specimens cited here as the same as that which Marr indicated for the taxa.

Ramaria magnipes is represented in Coker's herbarium (NCU) as one of several taxa under his concept of *Clavaria flava*. It was not included in Coker's (1923) book, having been sent by A.H. Smith, to whom the identification was returned.

Specimens examined: Idaho: Bonner Co., vic. Priest Lake, 14.vi.70, Scates no. 611, no. 47619 (TENN); Kootenai Co., Canfield Mt., 8.vi.71, Scates no. 1486, no. 47559 (TENN); Coeur d'Alene Nat. For., Deception Creek, 9.vii.70, Scates no. 1565, no. 47541 (TENN); Kootenai Co., Spirit Lake, 11.vi.71, Scates no. 1501, no. 47551 (TENN); Kootenai Co., Athol, 3.vi.71, Scates no. 1457, no. 47568 (TENN); Kootenai Co., Copper Mt., 7.vi.70, Scates no. 588, no. 47555 (TENN); Kooetnai Co., Spirit Lake, 7.vi.71, Scates no. 1478, no. 47552 (TENN); Kootenai Co., Spirit Lake, 9.vi.70, Scates no. 595, no. 47594 (TENN); Kootenai Co., Hayden Lake, 2.vi.71, Scates no. 1433, no. 47538 (TENN); Kootenai Co., Copper Mt., 3.vii.73, Scates no. 2626, no. 47599 (TENN); Kootenai Co., Windy Bay, 22.vi.71, Scates no. 1553, no. 47576 (TENN); Kootenai Co., vic. Rathdrum, 26.vi.76, nos. 45754, 45758, 45774 (TENN); Kootenai Co., 5.vi.84, no. 45757 (TENN); Kootenai Co., vic. Spirit Lake, 9.vi.70, coll. KS, Scates no. 596, no. 46657 (TENN); Valley Co., vic. McCall, 30.vi.76, nos. 40259, 40261, 40264 (TENN). Oregon: Morrow Co., Cutsforth County Park, 15.vi.85, coll. RHP and M. Rogers, no. 46674 (TENN). Washington: Mt Angeles, 28.vi.39, Smith no. 14678 (NCU, MICH).

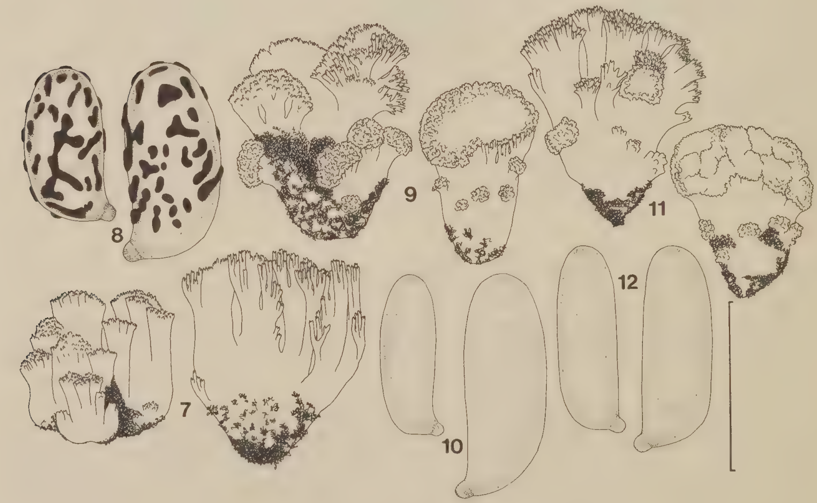
4a. *Ramaria magnipes* **var. *albidior*** Petersen, *var. nov.*

Ut variete typica, sed: 1) basidiocarpi subhypogeus, in terra firma sub humus; 2) rami et ramuli albi vel pallide cremei.

Fruitbodies (Fig. 11) up to 19 X 15 cm, ellipsoid to depressed-ellipsoid in outline, usually semiemergent. **Stipe** up to 8 X 6 cm, massive, single, mycelioid at base, rooting below humus layer in A-horizon, white, with common abortive stumps (usally without branchlets or dissected apices), recurved high on stipe, weakly brunnescent where handled; flesh white, often mottled with small hygrophanous spots. **Major branches** 3-4, erect, crowded, stout, not terete, sometimes slightly flaring, white below, white upward where protected, cream to ivory-colored where exposed ("warm buff," "pale ochraceous salmon," "Naples yellow," "cream color," "pale ochraceous buff"); flesh white, solid, crisp, brittle. **Branches** in 3-6 ranks, short, concolorous with upper major branches; internodes short when young, lengthening only in age and then diminishing abruptly at maturity; axils narrowly rounded. **Apices** molar-like when young, occasionally expanded into coarse, truncate or coarse-digitate processes by maturity, pale yellow when young, bright greenish yellow where unprotected ("mustard yellow," "amber yellow," "straw yellow," "Naples yellow"), usually with a blush of muted pink where exposed ("Japan rose," "onion skin pink," "pinkish cinnamon," "cinnamon buff," "pinkish buff"). **Odor** and **taste** negligible.

Macrochemical reactions: FCL = positive; IKI = negative on branch sections, tardily weakly positive on stipe flesh; ANO, ANW, PHN, PYR, KOH, NOH, SYR, TYR, GUA = negative.

Stipe tramal hyphae 6-12 μm diam, hyaline, thick-walled (wall up to 1.5 μm thick), tightly interwoven, locally



Figs. 7-12. Fruitbodies and basidiospores of *Ramaria* taxa. 7, 8. *R. marrii*. 7. Fruitbodies. TENN 45762. 8. Spores. TENN 45760. 9, 10. *R. magnipes* var. *magnipes* TENN 45754. 11, 12. *R. magnipes* var. *albidior*. 11. Fruitbodies. TENN 46682. 12. Spores. Holotype. Standard line = 10 μm for spores. Fruitbodies not to scale.

adherent or not so; ampulliform swellings rare, up to 12 µm broad, thick-walled, with stalactitiform ornamention; gloeoplerous hyphae occasional, yellow-refringent, 6-8 µm diam. Tramal hyphae of upper branches 4-9 µm diam, hyaline, thin- to thick-walled (wall up to 0.5 µm thick), often clamped, free, parallel; ampulliform swellings not observed; gloeoplerous hyphae rare, 5-7 µm diam, yellowish, refringent. Subhymenium rudimentary. Hymenium thickening; **basidia** 50-60 X 8-10, clavate, clamped; contents yellowish, multiguttulate; sterigmata 4, short, spindly.

Spores (Fig. 12) 10.8-11.9 X 3.6-4.3 µm ($E = 2.50$-3.20; $Em = 2.84$; $Lm = 11.49$ µm), subcylindrical to narrowly ellipsoid, flattened adaxially, smooth in profile; contents 1-2-guttulate, the guttules yellowish; wall up to 0.2 µm thick; hilar appendix small, eccentric; ornamentation none or a few obscure smudges.

Commentary: Typical fruitbodies of *R. magnipes* expand chiefly above the substrate level, and therefore show bright greenish yellow branches and intensely greenish yellow apices. Fruitbodies of var. *albidior* develop within the humus layer (with stipe base in A-horizon), breaking the surface only in adolescence. Consequently, branches are white to muted yellow while the apices are close to typical colors. Thus far, the form is known from the Sierra Nevada Mountains of California, where it appears to be the most common spring fruiter.

A single specimen from the Sierra Nevada (TENN no. 46678) showed stature and general coloration identical to those of *R. magnipes* var. *albidior*, but the flesh of upper branches was pallid salmon ("light pinkish cinnamon"). Macrochemical reactions were typical of *R. magnipes* (both varieties), ruling out *R. rubricarnata*.

Specimens examined: California: Sierra Co., Yuba Pass, 10.vi.85, no. 46678 (TENN); Sierra Co., Tahoe Nat. For., junction Weber Lake Rd. and Lincoln Valley Rd., 11.vi.85, no. 46670 (Holotype - TENN); Sierra Co., Tahoe Nat. For., Lincoln Creek Campground, 12.vi.85, no. 46682 (TENN).

5. ***Ramaria marrii*** Scates, *sp. nov.*

Basidiocarpi ad 15 X 9 cm, ellipsoidei ad crassi-ovati. Basi ad 6 X 4 cm, singulati, sine ramuli abortivi, laevi ad subtomentosi, cum rhizomorphi vulgati. Ramuli pallide brunnei, saepe avellaneo-brunnea. Apices carneobrunnei. Hyphae contextualae afibulatae, crassitunicatae; basidia 45-

60 X 8-10 µm, afibulatae; sterigmata 4. Sporae 8.6-11.6 X 4.3-5.4 µm, ellipsoidae ad tenuiovatae, subcorrugatae ad subverrucosae.

Fruitbodies (Fig. 7) up to 15 X 9 cm, ellipsoid to broadly ovate in outline. **Stipe** up to 6 X 4 cm, single, broadly rounded below, without abortive branchlets, smooth to minutely tomentose, often with 1-several slender, ropy, white rhizomorphs, white to off-white, chocolate brown where pressed by substrate objects, bruising brown to watery brown ("sayal brown," "Mikado brown," "ochraceous tawny," "buffy brown") where bruised, but hardly when cut; flesh solid, soft-spongy in large stipes, off-white ("pale pinkish buff"), often minutely marbled ("pale olive buff"), drying firm-friable to hard. **Major branches** 2-4, ascending, hardly terete, pallid tan below, upward concolorous with branches. **Branches** in 3-5 ranks, terete, light brown or flesh tan, often with avellaneous tints ("pinkish buff," "cinnamon buff," "chamois," "tilluel buff," "pale ochraceous buff," "vinaceous buff," 5A2-6B4), remaining so throughout development; internodes long below, diminishing abruptly at maturity; axils rounded to narrowly rounded. **Apices** somewhat terraced when young, crowded, minutely digitate, deep fleshy tan when young ("army brown," "wood brown," "fawn color," 8D4-5), fading somewhat by maturity. **Odor** negligible to slightly agaricoid; **taste** mildly bitter to weakly astringent.

On soil and duff in mixed coniferous forests, including *Pinus monticola* and *Abies grandis*.

Macrochemical reactions: FSW, FCL = strongly positive; PYR, ANO, ANW, GUA, PHN, IKI = negative.

Stipe tramal hyphae 6-14 µm diam, hyaline, clampless, thick-walled (wall up to 1.2 µm thick), tortuous, gnarled, tightly interwoven; ampulliform inflations up to 16 µm broad, aliiform, thick-walled (wall up to 1.2 µm thick), hardly ornamented; gloeoplerous hyphae not observed. Tramal hyphae of upper branches 4-12 µm diam, hyaline, clampless, thin-walled, parallel to subparallel, tightly packed, free to locally adherent. Subhymenium rudimentary. Hymenium thickening; **basidia** 45-60 X 8-10 µm, clavate, clampless; contents multiguttulate when mature, the guttule yellowish, refringent; sterigmata 4, spindly, lyriform.

Spores (Fig. 8) 8.6-11.6 X 4.3-5.4 µm (E = 1.67-2.23; Em = 2.08; Lm = 9.85 µm), ellipsoid to narrowly ovate, flattened adaxially, obscurely roughened in profile; contents uniguttulate, the guttule refringent, yellowish; wall up to 0.3 µm thick; hilar appendix papillate; ornamentation variable, from almost absent to narrow meandering ridges, to large discrete, low warts.

Commentary: Of the few taxa in the subgenus with tan or brown fruitbodies, most exhibit clamp connections. *Ramaria spinulosa* (Pers.: Fr.) Quel. (and its variety *diminutiva* Pet.) is clampless and the specimens cited below match *R. spinulosa* in the following ways: 1) fruitbody color; 2) lack of clamp connections; 3) macrochemical non-reactivity; 4) brunnescent bruising reaction; and 5) spores of similar dimensions.

Conversely, fruitbodies of *R. marrii* are bulkier, with generally heavy stipe, while those of *R. spinulosa* are slenderer, with modest, clean stipe. Stipe flesh in *R. marrii* is off-white (although brunnescent), while stipe flesh in *R. spinulosa* is consistently tan to tan-brown. When properly dried, flesh of specimens of *R. marrii* is easily pierced with a needle, but is not chalky-friable as in *R. spinulosa*. The spores of *R. spinulosa* are 1-several-guttulate, with the guttules dark and non-refringent, while *R. marrii* has uniguttulate spores, with the guttule strongly refringent and yellowish. Finally, *R. marrii* fruits vernally, so far in a restricted, inland area, while *R. spinulosa* fruits autumnally, and perhaps is restricted (in western North America) to coastal regions from California through Washington.

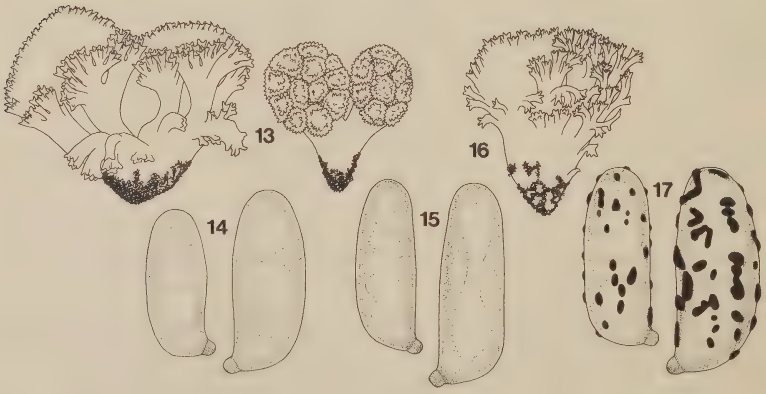
Our examination of the type specimens of *R. fumosiavellanea* Marr and Stuntz (SUCO: Marr no. 730) shows it to be conspecific with *R. spinulosa*.

The species epithet honors Dr. Currie D. Marr, student of *Ramaria*, author of the definitive publication on the genus in the northwest, and friend of both authors.

Specimens examined: Idaho: Kootenai Co., vic. Rathdrum, 26.vi.76, no. 45760 (TENN); Kootenai Co., vic. Hayden Lake, 26.vi.76, no. 45749 (TENN); Kootenai Co., vic. Spirit Lake, 6.vi.84, coll. KS, no. 45762 (TENN); Kootenai Co., 7.vi.84, no. 45756 (TENN); Kootenai Co., Hayden Lake, 17.vi.74, Scates no. 3113, no. 47577 (TENN); Kootenai Co., Coeur d'Alene Mt., 12.vi.71, Scates no. 1519, no. 47589 (TENN); Kootenai Co., Canfield Mt., 8.vi.71, Scates no. 1492, no. 47598 (holotype, TENN; isotype, herbarium CS); Kootenai Co., 11.vi.70, Scates no. 604, no. 47585 (TENN).

6a. *Ramaria rasilispora* [var. *rasilispora*] Marr and Stuntz. 1973. Biblioth. Mycol. 38: 107.

Fruitbodies (Fig. 13) up to 15 X 22 cm, circular to depressed-ellipsoid in outline, usually emergent from substrate but often semiemergent. **Stipe** up to 7 X 4 cm, usually smaller, single, obtusely rounded at base, usually wider than high, white, minutely tomentose between substrate particles, not brunnescent, commonly with abortive branchlets in the form of blunt or tapering stumps; flesh white, solid, usually mottled with watery spots, drying whitish, moderately hard. **Major branches** 2-4, ascending but not erect, more or less terete. **Branches** in 4-6 ranks, crowded when young, lengthening to rather open by maturity, more or less terete, pale ochraceous yellow ("pale ochraceous salmon," "warm buff," "cream color") to fleshy buff (4A2, 5-6A4-5); internodes diminishing gradually at maturity; axils rounded, often splitting; flesh white, homogeneous. **Apices** crowded when young, dentate to irregularly coarse at all ages, light yellow ("pinard yellow") to pastel chartreuse yellow ("amber yellow," "empire yellow," "wax yellow," "barium yellow," 2A3, 2-5A4-5), often blushing to "onion skin pink" where exposed to cold, dry air. **Odor** very weakly aromatic; **taste** negligible to weakly bitter.



Figs. 13-17. Fruitbodies and basidiospores of *Ramaria* taxa. 13, 14. *R. rasilispora* var. *rasilispora*. TENN 45753. 15. *R. rasilispora* var. *scatesiana*. TENN 45766. 16, 17. *R. rubricarnata* var. *verna*. 16. Fruitbody. TENN 45752. 17. Spores. TENN 45775. Standard line = 10 µm for spores. Fruitbodies not to scale.

Fruiting on soil and duff in mixed coniferous forests, including *Pinus monticola*, *Pseudotsuga menziesii*, and *Abies grandis*; throughout the range.

Macrochemical reactions: FSW, FCL = positive; IKI = slowly and weakly positive ("old gold"); PHN = rarely slowly positive; ANO, ANW, PYR, KOH, NOH, PDAB = negative.

Stipe tramal hyphae 10-33 µm diam, hyaline, clamped, not agglutinated or adherent, thick-walled (wall up to 4 µm thick), tightly interwoven; ampulliform inflations hardly swollen, usually thick-walled (wall up to 3 µm thick), with extensive and coarse stalactitiform ornamention; gloeoplerous hyphae occasional, 3-12 µm diam, yellow-refringent, strongly cyanophilous. Tramal hyphae of upper branches up to 17 µm diam, hyaline, clamped, thin- to locally thick-walled (wall up to 1.5 µm thick), parallel, free inward, adherent beneath hymenium; ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium rudimentary. Hymenium thickening; **basidia** 50-60 X 7-8 µm, clavate, clamped; contents homogeneous; sterigmata 4, slender, sublyriform.

Spores (Fig. 14) 8.3-11.5 X 3.6-4.3 µm (E = 2.30-3.00; Em = 2.57; Lm = 9.95 µm), cylindrical, occasionally subboletoid (swollen adaxially), smooth (at X1000); wall up to 0.2 µm thick; content 1-several-guttulate, the guttules amorphous, dark, non-refringent; ornamentation none or a very few slender meandering ridges.

Commentary: This is the most commonly collected taxon in many parts of the Pacific Northwest, and is eaten routinely by many people.

The only sure way to separate *R. rasilispora* from *R. magnipes* in the dried condition is spore length. Spores of *R. magnipes* are considerably longer (Lm = 11.7) than those of *R. rasilispora* (Lm = 9.95 µm). When fresh, upper branches and apices of *R. magnipes* are more intensely colored than those of *R. rasilispora*. Stipe surfaces in *R. magnipes* are easily brunnescent, while those in *R. rasilispora* are not so. In those herbarium specimens which we have examined, fruitbodies of *R. magnipes* dry darker, dingier, with harder, darker stipe flesh, whereas those of *R. rasilispora* are cream colored, with white flesh even when dry. Likewise, while our sampling is anything but exhaustive, dried specimens of *R. magnipes* seem always to be stocky, stout, with larger stipes and shorter branching patterns. Those of *R. rasilispora* var. *rasilispora* are usually much more open, with long lower branches and moderate-sized stipe. As stated under var. *scatesiana*, the two varieties of *R. rasilispora* are distinguished only with great difficulty in the dried condition, but when fresh, fruitbody branches of var. *rasilispora* are considerably more flesh-colored and apices brighter and deeper yellow than those of var. *scatesiana*.

Marr (in Marr and Stuntz, 1973) conjectured that *R. magnipes* and *R. rasilispora* belonged to a complex including *R. obtusissima* (Peck) Corner from eastern North America. Based on spore size and shape, and the very sparse ornamentation configuration in *R. obtusissima*, I (RHP) concluded (Petersen, 1986) that *R. obtusissima* belonged in subgenus *Ramaria* along with *R. botrytis, R. holorubella, R. strasseri* and others with striate spore ornamentation. To be sure, jonquil yellow coloration was anomalous in that subgenus, in which the nearest colors are tan to fleshy tan (in *R. strasseri* and similar taxa). Furthermore, Schild (1982) has described *R. gypsea* and Petersen (1988) has proposed *R. schildii*, both smooth-spored from Europe. While both seem clearly to belong in subgenus *Laeticolora*, they represent different species alliances. While smooth-spored taxa might be expected in both subgenera, when auxiliary characters are used it seems increasingly probable that *R. obtusissima* can be placed in subg. *Laeticolora*.

For more discussion, see under *R. magnipes*.

Specimens examined: California: Sierra Co., Tahoe Nat. Forest, 9.vi.86, no. 56163 (TENN); same location, 11.vi. 86, nos. 57177, 56178, 56182 (TENN); Idaho: Benewah Co., vic. Emida, 29.v.74, Scates no. 3065, no. 47561 (TENN); Bonner Co., Coolin, 16.vi.71, Scates no. 1530, no. 47549 (TENN); Kootenai Co., Farragut, 23.v.71, Scates no. 1393, no. 47569 (TENN); Kootenai Co., 7.vi.71, Scates no. 1475, no. 47548 (TENN)); Kootenai Co., Hayden Lake, 15.vi.70, Scates no. 617, no. 47607 (TENN); Kootenai Co., 26.vi.76, coll. T. & F. Vocht, no. 45764 (TENN); Kootenai Co., Hayden Lake, 27.v.70, Scates no. 553, no. 47608 (TENN); Kootenai Co., Hayden Lake, 2.vi.71, Scates no. 1462, no. 47615 (TENN); Keootnai Co., Spirit Lake, 21.vi.74, Scates no. 3115, no. 47554 (TENN); Kootenai Co., 6.vi.84, coll. K. Scates, no. 45753 (TENN); Kootenai Co., E. Hayden Creek Rd., 27.v.70, Scates no. 550, no. 47590 (TENN); Kooetnai Co., Hayden Lake, 3.vi.71, Scates no. 1453, no. 47573 (TENN); Kootenai Co., Five Finger Saddle, 29.vi.71, Scates no. 1573, no. 47581 (TENN); Kootenai Co., vic. Spirit Lake, 9.vi.70, Scates, no. 599 no. 46661 (TENN); Kootenai Co., Swan Mt., 7.vi.70, coll. R. Warner, Scates nos. 584 (TENN no. 46662), 587 (TENN no. 46647). Oregon: Jefferson Co., Deschutes Nat. For., Suttle Lake Rd., 18.vi.85, no. 46676 (TENN); Morrow Co., Cutsforth Co. Park, 15.vi.85, coll. RHP & M. Rogers, no. 46674 (TENN); Mt. Hood Nat. For., east side of Mt. Hood, 16.vi.85, no. 46668 (TENN). Washington: Clear Lake, 13.vi.74, Scates no. 3104, no. 47560 (TENN).

6b. *Ramaria rasilispora* var. *scatesiana* Marr & Stuntz. 1973. Biblioth. Mycol. 38: 108.

Fruitbodies up to 24 X 8 cm, circular to obovate in outline. **Stipe** up to 6 X 4 cm, usually smaller, single, rounded at base, smooth above, often mycelioid at base, often with blunt abortive protuberances, white to off-white ("pale cinnamon pink"), not tomentose, not brunnescent or very weakly so upward on handling; flesh white, solid, homogeneous, drying firm-friable with hard rind. **Major branches** 2-4, ascending, hardly terete. **Branches** in 4-6 ranks, somewhat crowded when young, open at maturity, more or less terete, pale to light ochraceous cream-colored ("pale ochraceous buff," "pale ochraceous salmon," "pale yellow orange," "cream buff," "light ochraceous buff," 3-4A2-3) sometimes with a hint of pink in age "cream buff," "light ochraceous buff," "pinkish buff"); flesh white, somewhat stringy; internodes diminishing upward gradually at maturity; axils rounded to obtusely angled. **Apices** crass at all ages, molar-like when young, expanding by maturity to bluntly cauliflower-like to obtusely angled, clear yellow ("maize yellow") to pastel greenish yellow when young ("straw yellow," "cream color," "pale ochraceous salmon," "Naples yellow"), mellowing to buff-colored ("warm buff"), in age often with a hint of pink ("pinkish cinnamon," "pinkish buff"). **Odor** negligible to weakly fragrant; **taste** negligible to weakly musty or krauty.

Macrochemical reactions: FSW, FCL = positive; SYR = sometimes positive in upper branches, negative on stipe flesh; GUA, GHO, CRE, ANO, ANW, PYR, PHN, NOH, KOH, TYR = negative; IKI = negative to weakly positive on stipe flesh.

Stipe tramal hyphae 4-14 µm diam, hyaline, usually (but not invariably) clamped, thick-walled (wall up to 2 µm thick, usually undulate), not agglutinated or adherent, tightly interwoven; ampulliform inflations not observed; gloeopleous hyphae rare, yellow-refringent, 4-8 µm diam, undelimited, with occasional abrupt inflations. Tramal hyphae of upper branches 5-18 µm diam, hyaline, usually (but not invariably) clamped, thick-walled (wall up to 1.5 µm thick, often undulate), free inward, adherent and narrower outward, parallel; ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium extensive; hyphae 2-4 µm diam, parallel inward, tightly interwoven outward. Hymenium thickening; **basidia** 60-70 X 7-8 µm;

sterigmata spindly, more or less straight.

Spores (Fig. 15) 9.4-11.9 X 3.2-4.3 µm (E = 2.50-3.22; Em = 2.85; Lm = 10.62 µm), cylindrical to subboletoid, almost smooth; contents univacuolate to guttulate, with guttules dark, amorphous, non-refringent; wall up to 0.3 µm thick; hilar appendix gradual; ornamentation absent or a few slender, meandering ridges.

Commentary: Marr (in Marr and Stuntz, 1973) separated this variety from var. *rasilispora* "by its [var. *scatesiana*] paler colored fruitbodies, cream to pale yellow." Branch color in var. *rasilispora* was given as (colors from Kornerup and Wanscher, 1967): "young branches dull 'light yellow' (5A4-5) to 'apricot yellow' (5B6) maturing pale 'grayish orange' (5B4-5)," while branch color of var. *scatesiana* was "'yellowish white' (4A2) to 'light yellow' (4-5A3-4)." No distinction was made on color of apices, which was stated (under var. *rasilispora* as "apices concolorous [with branches] or turning 'dark brown' (7E6) with age ..." My observations agree quite closely as to branch color, but I find the color of the apices to be somewhat brighter and greener when young. Specimen TENN 45766 was collected by both authors together, from the type mycelium of var. *scatesiana*, and exhibited these colors well.

Spores are somewhat variable, and means are between those of var. *rasilispora* and *R. magnipes*. Upper branch tramal hyphae are identical to those of var. *rasilispora*.

All in all, the taxa within the *R. magnipes* - *R. rasilispora* complex are difficult to separate. Variety *scatesiana* seems vernal and autumnal, but the other three taxa appear vernal only. I (RHP) have seen fruitbodies of the complex in the field as far south as Sequioa National Park in California, but conditions prevented more accurate identification. Moreover, *R. rasilispora* var. *scatesiana* is macroscopically quite similar to *R. thiersii* (*q.v.*), but the two are separable on macrochemical and microscopic characters.

Just as in *R. magnipes*, fruitbodies of *R. rasilispora* var. *scatesiana* from drier habitats develop within the humus layer and are not exposed to sunlight until adolescence. Colors are generally paler than in typical material, but exposed branch apices are light bright yellow to pallid greenish yellow. Otherwise, micromorphology and macrochemical reactions match typical *R. rasilispora* var. *scatesiana*.

Scates no. 619 (TENN no. 46663) showed no clamp connections on tramal or subhymenial hyphae, but small, abrupt basidial clamps were present. It is necessary, therefore, to examine basidia, for the tramal hyphae of *R. coulterae* are clampless, as are the basidia. Tramal hyphae of *R. vinosimaculans* are also often clampless, but fruitbody morphology and color easily separate it from both varieties of *R. rasilispora*.

Specimens examined: California: Sierra Co., Yuba Pass, 10.vi.85, nos. 46686, 56110 (TENN); Sierra Co., Tahoe Nat. For., junction Weber Lake Rd. and Lincoln Valley Rd., 11.vi.85, no. 46684 (TENN); Sierra Co., Tahoe Nat. For., Lincoln Creek Campground, 12.vi.85, nos. 46675, 46666 (TENN); Sierra Co., Tahoe Nat. Forest, 8.vi.86, coll. R. Halling, nos. 47002, 46995 (TENN); same location, 11.vi.86, coll. H. Saylor, no. 47005 (TENN). Idaho: Kootenai Co., vic. Hayden Lake, 26.vi.84, coll. E. Coulter, no. 45766 (TENN); Kootenai Co., vic. Spirit Lake, 6.vi.84, no. 45768 (TENN); Kootenai Co., E. Hayden Creek Rd, 7.vi.70, Scates, no. 592 (holotype, SUCO; isotype, TENN no. 46660); Kootenai Co., E. Hayden Creek Rd., 15.vi.70, Scates nos. 617 (TENN no. 46659), 619 (TENN no. 46665); Kootenai Co., vic. Spirit Lake, 9.vi.70, Scates no. 601, no. 46658 (TENN); Kootenai Co., Hayden Lake, 3.vi.71, Scates no. 1455, no. 47542 (TENN); Kootenai Co., Canfield Mt., 21.vi.70, Scates no. 636, no. 47553 (TENN); same place, 8.vi.71, Scates nos. 1493 (TENN no. 47539 1495 (TENN no. 47600); same place, 29.v.70, Scates no. 555, no. 47616 (TENN); Co., vic. Hayden Lake, 22.vi.71, Scates no. 1552, no. 47597 (TENN). Washington: Mt. Rainier Nat. Park, Tahoma Creek, 15.x.84, no. 45861 (TENN); location unknown, 13.x.84, coll. Puget Sound Mycological Society, no. 45856 (TENN).

7. *Ramaria rubricarnata* [var. *rubricarnata*] Marr and Stuntz. 1973. Biblioth. Mycol. 38: 113.

Fruitbodies up to 11 X 9 cm, usually smaller, obpyriform to subcircular in outline. **Stipe** up to 6 X 5 cm, large to massive, single, with common clusters of abortive branchlets, off-white (5A2), minutely pruinose in some areas, the pruina easily rubbed off and then weakly brunnescent; abortive branchlets cauliflower-like, white where protected; flesh white, solid, homogeneous to minutely mottled, moist but not slippery or gelatinous, drying yellow ("buff yellow") over extensive areas. **Major branches** 2-4, short, hardly terete, pale pastel salmon. **Branches** in 4-6 ranks, short, hardly terete, compact, pallid salmon buff ("light ochraceous salmon," "pinkish buff," "pale ochraceous salmon," paler than "light ochraceous salmon," 6A-B4, 4-5A5, 5A6, 5A2-3) to occasionally yellow ("buff yellow," "apricot yellow," "light orange yellow"); flesh pastel salmon to salmon ("light ochraceous salmon," "capucine buff"); internodes all short, diminishing gradually upward to abruptly at maturity; axils acute to rounded. **Apices** crowded, pluridentate at all ages, light yellow, to yellow ("buff yellow," "apricot yellow," "baryta yellow," "light cadmium," 3A4, 4A2-5G), darkening in age (5B4). **Odor** and **taste** negligible.

Macrochemical reactions: FSW, FCL, ANW, IKI, SYR = positive; PYR, GUA, PHN = sometimes positive; ANO, TYR = negative.

Stipe tramal hyphae 5-14 µm diam, hyaline, clamped, thick-walled (wall up to 0.5 µm thick), not adherent, undulate to serpentine; ampulliform inflations occasional, as clamp connections, aliiform, up to 17 µm broad, thick-walled (wall locally up to 1 µm thick), with extensive stalactitiform ornamention; gloeoplerous hyphae not observed. Tramal hyphae of upper branches 5-17 µm diam, hyaline, often with somewhat dense, oily contents, clamped, thick-walled (wall up to 1 µm thick), more or less parallel, free; ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium extensive; hyphae 1.5-2.5 µm diam, tightly interwoven. Hymenium thickening; **basidia** 70-80 X 8-9 µm, clavate, clamped; contents multiguttulate at maturity; sterigmata 4, spindly, sublyriform.

Spores 8.6-11.2 X 4.0-4.7 µm (E = 2.00-2.67; E^m = 2.32; L^m = 9.99 µm), ellipsoid, obscurely roughened in profile; contents dense, oily, often with 1-several amorphous, dark guttules, occasionally with a single, dark, well- defined, subrefringent guttule; wall up to 0.2 µm thick; hilar appendix gradual, not prominent; ornamentation of low small warts and short meandering ridges.

Commentary: Marr (in Marr and Stuntz, 1973) furnished careful color notes for his collection of *R. rubricarnata*: "Stipe of fresh fruiting body white to 'orange white' (5-6A2) near the emerging branches ..." This color equates well to "pale pinkish cinnamon" of Ridgway (1912), but not to yellow colors, as occur in the other vernal varieties. All of Marr's specimens were gathered in October and November, and were typical of the autumnal taxon. A photo of the type (Marr 800, SUCO, seen viii.85) shows a large, single, white, smooth stipe devoid of bruising reactions, with branches loosely cauliflower-like and pallid salmon.

Tips are coarse and yellow.

Vernal specimens of the typical variety show somewhat longer branches and apices than autumnal fruitbodies, but spore dimensions and statistics are extremely similar to autumnal collections (spores for my autumnal collections: 9-11.2 X 3.6-4.7 µm; E = 2.08-2.82; E^m = 2.47; L^m = 9.89 µm). For characters separating the varieties of *R. rubricarnata*, see under var. *verna*.

Specimens examined: Idaho: Benewah Co., vic. Emida, 29.v.74, Scates no. 3062, no. 47546 (TENN); Coeur d'Alene Co., Swan Mt., 7.vi.70, coll. R. Warner, Scates no. 586, no. 47611 (TENN); Kootenai Co., 7.vi.71, scates no. 1471 (TENN); Kootenai Co., Spirit Lake, 9.vi.70, Scates no. 598, no. 47587 (TENN); Kootenai Co., E. Hayden Creek Rd., 7.vi.70, Scates no. 580, no. 47545 (TENN); Kootenai Co., Spirit Lake, 7.vi.78, Scates no. 4937, no. 47562 (TENN); Kootenai Co., vic. Coeur d'Alene, 11.vi.75, Scates no. 3357, no. 47540 (TENN).

7a. *Ramaria rubricarnata* ***var. pallida*** Petersen & Scates, *var. nov.*

Ut varietate typica, sed: 1) fructifer vernalis; 2) rami deorsum cremea; 3) sporae >11 µm longae; 4) care baso sicco albo; 5) ramuli cremea; et 6) caro ramulorum incarnata.

Fruitbodies up to 13 X 10 cm, broadly obovate to subcircular in outline. **Stipe** up to 5 X 7 cm, broadly tapering to a rounded base, usually with some recurved, abortive stumps but not branchlets, white, smooth to pruinose where protected, weakly or not brunnescent; abortive stumps white; flesh white, solid, sometimes minutely streaked, stringy. **Major branches** 3-5, hardly terete, off-white ("pale pinkish cinnamon"). **Branches** in 4-6 ranks, divergent to flairing, buff-colored to pallid buffy yellow with a hint of salmon ("light ochraceous buff," "pinkish buff," "cream color," lighter than "light ochraceous salmon"); flesh streaked off-white and "pinkish buff;" internodes diminishing abruptly at maturity; axils rounded. **Apices** blunt, cuspidate, dull greenish yellow ("amber yellow," "mustard yellow") when young, by maturity divergent, blunt, light yellow ("buff yellow"). **Taste** and **odor** negligible to mildly fabaceous.

Macrochemical reactions: FCL, PYR, ANW, GUA, IKI, SYR = positive; KOH, GHO, PHN, CRE = negative; ANO = capriciously positive.

Stipe tramal hyphae 3-9 µm diam, hyaline, often clamped, thick-walled (wall uncommonly up to 1.5 µm thick), not agglutinated or adherent, tightly packed; ampulliform inflations not observed; gloeoplerous hyphae occasional, 3-8 µm diam, thin-walled, yellow-refringent, with common abrupt inflations. Tramal hyphae of upper branches 3-12 µm diam, hyaline, usually clamped, thin- to thick-walled (wall rarely up to 1.5 µm thick), not agglutinated or adherent, densely packed, parallel. Subhymenium extensive; hyphae 1.5-2.0 µm diam, densely interwoven, clamped. Hymenium thickening; **basidia** 65-72 X 9-11 µm, clavate, clamped; contents densely multiguttulate at maturity, yellow; sterigmata 4, lyriform, delicate.

Spores 9.7-14.4 X 4.0-4.7 µm (*E* = 2.25-3.30; *Em* = 2.68; *Lm* = 11.44 µm), ellipsoid to subcylindrical, obscurely roughened in profile; contents yellowish, homogeneous to obscurely 1-several-guttulate, the guttules dark ochre, refringent; wall up to 0.2 µm thick; hilar appendix not prominent, with moderate throat; ornamentation of small, low warts and scattered meandering ridges.

Commentary: When the key by Marr and Stuntz (1973) is used, one is led to *R. rubricarnata* [var. *rubricarnata*]. Fruitbodies of the typical variety exhibit more vivid colors, smaller stipes and generally shorter, stockier branches than those of var. *pallida*. Variety *verna* does not differ significantly in stature or color from the typical variety, but var. *pallida*, however, produces longer major and secondary branches, and muted colors of branches and branch flesh. All three varieties share weakly amyloid flesh, macrochemical reactivity, salmon outer branch flesh underlying a yellow hymenium, slow syringaldazine reactions, roughened spores of comparable dimensions, and presence of clamp connections.

Quite similar in fruitbody stature and color is *R. thiersii*, fruitbody flesh of which is macrochemically active and produces a rapid reaction with SYR, but unlike *R. rubricarnata* var. *pallida*, fruitbody flesh in inamyloid. In *R. thiersii* branch colors usually do not include any salmon tint, branch flesh is pure white, and all parts show conspicuous brunnescence where handled or rubbed. The stipe appears large, but usually is cleft deeply by the major branches.

The characters which diagnose var. *pallida* are subtle, and require a sharp eye. All cited specimens were first listed as *R. rubricarnata* var. *verna*, and when it became obvious that they were not contaxic, they were placed under *R. thiersii*. Positive reaction with IKI and rapid, strong reaction with SYR separate the two.

Specimens examined: California, Sierra Co., Tahoe Nat. Forest, 8.vi.86, coll. R. Halling, no. 47082 (Holotype, TENN); same data, nos. 47091, 47092 (TENN); same location, 9.vi.86, nos. 47090, 47083 (TENN); same location, 10.vi.86, coll. Tom Pugh, nos. 47078, 47080 (TENN). Idaho, Bonner Co., vic. Coolin, 4.vi.71, Scates no. 1461, no. 47096 (TENN); Kootenai Co., vic. Spirit Lake, 7.vi.71, Scates no. 1477, no. 47087 (TENN); Canfield Mt., 8.vi.71, Scates no. 1488, no. 47088 (TENN); Kootenai Co., Spirit Lake, 1.vi.71, Scates no. 1423, no. 47084 (TENN); Kootenai Co., Spirit Lake, 29.v.72, Scates no. 1884, no. 47085 (TENN); E. Hayden Lake, 1.vi.75, Scates no. 3346, no. 47093 (TENN); Sisson's Flats, 6.vi.71, Scates no. 1466, no. 47094 (TENN); E. Hayden Creek Rd., 8.vi.74, Scates no. 3093, no. 47095 (TENN); Huckleberry Hill, Panhandle Natl. Forest, 23.vi.74, Scates no. 3121, no. 47098 (TENN); Kootenai Co., Spirit Lake, 27.v.80, Scates no. 5812, no. 47089 (TENN).

7b. *Ramaria rubricarnata* **var. *verna*** Petersen and Scates, *var. nov.*

Ut varietate typica, vel: 1) fructifer vernalis; 2) rami flavi; 3) sporae 10.4-12.2 X 4-5 µm; et 4) caro stipito sicco albo.

Fruitbodies (Fig. 16) up to 9 X 7 cm, obpyriform to subcircular in outline. **Stipe** up to 4 X 3 cm, single, large, with common clusters of abortive branchlets, white, minutely pruinose in some areas, the pruina easily rubbed off, and there very weakly watery brunnescent; abortive branchlets cauliflower-like, white where protected; flesh white, solid, homogeneous, drying white, firm. **Major branches** 2-4, hardly terete, short; upper stipe and lower branches light yellow ("baryta yellow," "maize yellow"). **Branches** in 3-5 ranks, terete, salmon-orange to light salmon ("light ochraceous salmon," "light ochraceous buff," "ochraceous salmon," "salmon color," "capucine orange"), vinescent ("light vinaceous fawn") around soil particles; flesh usually brighter salmon or salmon-orange ("light salmon orange," "orange pink," "salmon buff," "mikado orange,"), internodes all short, diminishing upward gradually in adolescent specimens; axils acute to narrowly rounded. **Apices** yellow to rich yellow ("buff yellow," "light orange yellow," "apricot yellow," "light cadmium"), quickly fading to concolorous with branches. **Odor** negligible to weakly fabaceous; **taste** negligible.

Macrochemical reactions: FSW, FCL, GUA, ANW, PHN, IKI = positive; PYR, ANO = probably positive (only one test performed); PDAB = negative; SYR, TYR = not performed.

Stipe tramal hyphae 5-15 µm diam, hyaline, clamped, thick-walled (wall up to 0.5 µm thick), not agglutinated or adherent, undulate to serpentine; ampulliform inflations occasional, as clamp connections, aliiform, up to 17 µm broad, thick-walled (wall locally up to 1 µm thick), with extensive stalactitiform ornamention; gloeoplerous hyphae not observed. Tramal hyphae of upper branches 5-17 µm diam, hyaline, often with somewhat sludgy contents, clamped, thick-walled (wall up to 1 µm thick), more or less parallel, not agglutinated or adherent, ampulliform inflations and gloeoplerous hyphae not observed. Subhymenium extensive; hyphae 1.5-2.5 µm diam, tightly interwoven. Hymenium thickening; **basidia** 70-80 X 8-9 µm, clavate, clamped; contents multiguttulate at maturity, strongly cyanophilous; sterigmata 4, spindly, sublyriform.

Spores (Fig. 17) 10.4-12.2 X 4.0-5.0 µm (E = 2.21-2.82; Em = 2.55; Lm = 11.09 µm), ellipsoid, delicately but distinctly roughened in profile; contents with 1-3 well-defined, subrefringent guttules; wall up to 0.2 µm thick; hilar appendix gradual, not prominent; ornamentation of very delicate, small, low warts and/or short meandering ridges.

Commentary: The several characters which separate the varieties of *R. rubricarnata* are shown in Table I.

With these character differences, one might question why the varieties are not proposed as separate species. Several characters link them, namely: 1) General color of branches and apices; 2) general color of branch flesh; 3) amyloidity and general macrochemical reactivity of the flesh; and 4) presence of clamp connections.

Fruitbody macromorphology combines characters similar to those of other taxa. For example, *R. formosa* combines the salmon branches and yellow apices, while abortive branchlets occur in several taxa, including *R. coralcolor* Coker apud Pet. and *R. piedmontiana* Coker apud Pet.. Much less common is the strong macrochemical reactivity of branch flesh. All told, I judge that the overlapping characters convey conspecificity, but that the specimens can be separated at the varietal rank.

Specimens examined: California: Sierra Co., Tahoe Nat. Forest, ii.vi.86, no. 47009 (TENN). Idaho: Benewah Co., vic. Emida, Little John Creek Rd., 29.v.74, Scates no. 3064, no. 47077 (TENN); Kootenai Co.,

TABLE I

Varieties of *Ramaria rubricarnata*

var. *rubricarnata*	var. *verna*	var. *pallida*
1. Autumnal fruiter	Vernal fruiter	Vernal fruiter
2. Lower branches stocky, concolorous with branches	Lower branches stocky, yellow	Lower branches elongate, cream-colored
3. Spore Lm = <10 µm.	Spore Lm = >11 µm.	Spore Lm = >11 µm
4. Dried stipe flesh yellow	Dried stipe flesh white	Dried stipe flesh white
5. Upper branches salmon-colored; stocky	Upper branches salmon-colored; stocky	Upper branches cream-colored; elongate
6. Branch flesh bright salmon	Branch flesh bright salmon	Branch flesh pallid pinkish

7.vi.84, coll. E. Coulter, no. 45775 (TENN); vic. Coeur d'Alene, 5.vi.84, no. 45752 (TENN); E. Hayden Creek Rd., 26.vi.76, coll. M. Bueg, no. 45755 (TENN); vic. Spirit Lake, 9.vi.70, coll. KS, Scates no. 595, no. 46651 (TENN); Variety Corner, 7.vi.70, Scates no. 577 (TENN); E. Hayden Creek Rd., 15.vi.70, Scates no. 616, no. 46655 (TENN); Fourth of July Canyon, 7.vi.70, coll. C. & L. Chariton, Scates no. 589, no. 46653 (TENN); Shoshone Co., Lost Mine Rd., 23.vi.74, Scates no. 3122, no. 47602 (TENN).

8. ***Ramaria thiersii*** Petersen and Scates, *sp. nov.*

Basidiocarpi ad 15 X 8 cm, obpyramidi ad subcylindrici, in terra firma sub humus. Basi ad 7 X 6 cm, subattentuati, albi, laevi, sine ramuli abortivi, contusi brunnescenti; caro albo. Ramuli albi vel pallide flavi; caro albo ad salmonicolor. Apices digitati, pallide viridoflavi; sectiones ramorum in soluto macrochemico affirmo. Hyphae contextualae tenui- ad crassitunicatae, fibulatae; basidia 45-50 X 7-8 µm, clavata, fibulata. Sporae 12.2-15.1 X 4-4.7 µm, cylindricae ad tenui-ellipsoidae, subcorrugatae.

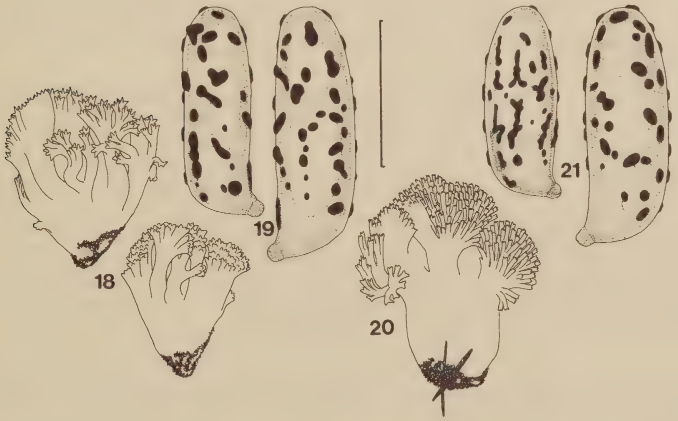
Fruitbodies up to 15 X 8 cm, obpyramidal to subcylindrical in outline; usually under litter layer in gritty soil. **Stipe** up to 7 X 6 cm, obpyramidal, tapering downward to narrowly rounded base, often sub- geniculate, white, smooth, without abortive branchlets or stumps, weakly to strongly brunnescent where rubbed or bruised; flesh white, not mottled, soft to spongy, often grub-ridden. **Major branches** 3-5, ascending to flaring, often split and splintered, hardly terete, white to pale yellow ("pale buff"). **Branches** in 4-6 ranks, terete, erect to flaring, often grooved, white to pallid yellow ("pale ochraceous salmon," "light ochraceous buff," "cream buff," "cartridge buff," 5A2); flesh soft, stringy, white in hypogeous forms, salmon-colored in exposed fruitbodies; internodes diminishing upward gradually at maturity; axils rounded, often split below. **Apices** digitate to molar-like when young, coarsely digitate by maturity, white where protected, pallid greenish yellow where exposed ("cream color," "straw yellow," "colonial buff," "Naples yellow," 4A2, 5A2-4). **Odor** and **taste** negligible.

Macrochemical reactions: ANO, ANW, PYR, PHN, FCL, SYR = positive to strongly positive; KOH = darkening on hymenium; NOH, TYR, IKI = negative.

Stipe tramal hyphae 3-12 µm diam, hyaline, clamped, locally adherent, tightly interwoven, thin- to thick-walled (wall up to 1 µm thick); ampulliform inflations as clamps, up to 13 µm broad, ellipsoid, thick-walled (wall up to 2 µm thick), with extensive and coarse stalactitiform ornamentation; gloeoplerous hyphal system represented by short lengths of yellow-refringent hyphae 3-5 µm diam. Tramal hyphae of upper branches 4-12 µm diam, hyaline, thin- to thick-walled (wall up to 1 µm thick), clamped, more or less parallel, extensively but not exclusively adherent; ampulliform inflations rare, thin-walled, with extensive but delicate stalactitiform ornamentation; gloeoplerous hyphal system as above, and of bulbous, refringent hyphal tips. Subhymenium rudimentary. Hymenium thickening; **basidia** 45-50 X 7-8 µm, clavate, clamped; contents granular to minutely multiguttulate; sterigmata 4, stout, straight, subcoronate.

Spores (Fig. 19) 11.6-15.8 X 4.0-5.0 µm (E = 2.46-3.55; Em = 3.13; Lm = 13.28 µm), cylindrical to narrowly ellipsoid, occasionally subsigmoid, obscurely roughened in profile; contents uni- to bi-guttulate, the guttules yellow-refringent; wall up to 0.2 µm thick; hilar appendix small, gradual; ornamentation of small, discrete low warts; struma low, refringent, cyanophilous.

Commentary: Of the several fruitbodies we have seen, most were beneath the soil level and covered with gritty soil when collected. In this condition, colors are virtually absent. When exposed to sunlight during development, the yellow pigmentation is expressed, and in



Figs. 18-21. Fruitbodies and basidiospores of *Ramaria* taxa. 18, 19. *R. thiersii*. 18. Fruitbodies. TENN 46672. 19. Spores. TENN 46677. 20, 21. *R. vinosimaculans*. 20. Fruitbody. TENN 45748. 21. Spores. TENN 45933. Standard line = 10 µm for spores. Fruitbodies not to scale.

this condition, fruitbodies closely resemble those of *R. rasilispora* var. *scatesiana* in stature and color. Three characters easily separate the two, however: 1) branch sections and stipe flesh of *R. thiersii* react strongly with most reagents; 2) stipe flesh of *R. thiersii* is inamyloid; and 3) spores of *R. thiersii* are roughened and average over 13 µm in length. In *R. rasilispora* var. *scatesiana*, branch sections are non-reactive, stipe flesh is slightly amyloid and spores are smooth and average about 10 µm in length.

Separation from *R. rubricarnata* var. *pallida* is more difficult, but see under that name for more discussion.

To this time, the species is known only from high altitudes (over 5000 ft) in the Sierra Nevada Mountains of California, and from northern Idaho. The California fruitings are often difficult to find because of the semi-hypogeous habit. Fruitbody stature is very variable, dictated at least in part by weather. In the normally drier Sierra Nevada, fruitbodies are subhypogeous and therefore pale in color, but in wetter northern Idaho, fruitbodies usually develop above ground, are larger and more brightly colored. In the latter form, branch flesh is usually somewhat salmon colored, but not so as to give hymenial surface this hue.

The species epithet honors Harry D. Thiers, long a student of western North American fungi, invaluable help in western field work, and for many years good friend of both authors.

Specimens examined: California: Sierra Co., Tahoe Nat. For., Lincoln Creek Campground, 12.vi.85, no. 46671 (Holotype - TENN); Sierra Co., Nat. For. Rt. 12, vic. church camp, 13.vi.85, alt. ca. 7300 ft., no. 46677 (TENN); Sierra Co., Yuba Pass, 10.vi.85, nos. 46672, 46673 (TENN); Sierra Co., Tahoe Nat. For., junction Weber Lake Rd. and Lincoln Valley Rd., 11.vi.85, no. 46664 (TENN); Sierra Co., Tahoe Nat. Forest, 9.vi.86, nos. 56166, 56174 (TENN); same location, 10.vi.86, no. 56168 (TENN); same location, ii.vi.86, no. 56183 (TENN). Idaho: Bonner Co., Priest Lake, 16.vi.71, Scates no. 1525 (TENN no. 47617); Bonner Co., vic. Collin, 4.vi.71, Scates no. 1459, no. 47603 (TENN); Kootenai Co., Hayden Creek, vi.70, Scates no. 581, no. 47618 (TENN); Kootenai Co., E. Hayden Creek Rd., 27.v.70, Scates no. 551, no. 47544 (TENN).

9. *Ramaria vinosimaculans* Marr & Stuntz. 1973. Biblioth. Mycol. 38: 128.

Fruitbodies (Fig. 20) up to 11 X 13 cm, depressed-ellipsoid to sphaeropedunculate in outline. **Stipe** up to 4 X

4 cm (usually smaller), single, rounded at base to tapering downward, smooth, minutely tomentose between substrate particles, often with a few abortive branchlets, not brunnescent but appearing hygrophanous when handled or bruised, white to off-white (4A2), staining at base to peachy tan (7B4-6) maroon or vinaceous brown ("Pompeian red," "Vandyke red," "hydrangea red," "Corinthian red," "vinaceous brown," "Etruscan red," "Hay's russet," "Hessian brown," 10-11E7-8, 8C-D7-8) in spots, slowly becoming brown; flesh white, solid, homogeneous, drying firm-friable with hard rind. **Major branches** 2-3, ascending to divaricate, hardly terete, off-white. **Branches** in 3-5 ranks, crowded when young, open at maturity, very pale cream color to yellow ("pale cinnamon pink," "light buff," "pale ochraceous salmon," "cartridge buff," "maize yellow," " straw yellow," 3-5A2-3), often vinaceous around soil particles; flesh white, homogeneous, crisp; internodes diminishing upward gradually at maturity; axils narrowly rounded. **Apices** crowded and somewhat terraced when young, pluridentate, somewhat divergent at maturity, jonquil yellow to slightly greenish yellow when young ("buff yellow," "maize yellow," "cream color," "Naples yellow," 2A3-4, 4-5A2-4, 4A5), paler where protected, in age occasionally discoloring to pallid brown ("fawn color," 7C5). **Odor** fresh, mildly spicy or fragrant, perhaps of tobacco; **taste** negligible.

Fruiting under mixed coniferous forests, including *Tsuga heterophylla*, *Abies grandis*, and *Thuja plicata*.

Macrochemical reactions (see commentary below): FSW, FCL = positive; KOH, NOH, PHN, PYR, ANO, ANW, IKI, PDAB = negative; GUA = negative on branch sections, positive on stipe flesh and surface.

Stipe tramal hyphae 4-17 µm diam, hyaline, usually (but not invariably) clamped, thin- to thick-walled (wall up to 0.5 µm diam), tightly interwoven, not agglutinated or adherent, acyanophilous; ampulliform inflations occasional, scallion-shaped, thick-walled (wall up to 0.5 µm thick), with extensive but very delicate stalactitiform ornamentation; gloeoplerous hyphae 4-7 µm diam, not discernable under phase microscopy, but cyanophilous. Tramal hyphae of upper branches 5-15 µm diam, hyaline, usually (but not invariably) clamped, thick-walled (wall up to 0.5 µm thick), parallel, free to locally adherent. Subhymenium rudimentary, abrupt; hyphae 1.5-2.5 µm diam, tightly interwoven. Hymenium thickening; **basidia** 50-65 X 7-8 µm, clavate, clamped; contents densely multiguttulate at maturity; sterigmata 4, spindly, short, divergent.

Spores (Fig. 21) 11.2-14.0 X 4.3-5.0 µm (*E* = 2.38-3.08; *Em* =2.76; *Lm* = 12.51 µm), narrowly ellipsoid, often with suprahilar depression, obscurely roughened in profile; contents several-guttulate, the guttules obscure, subrefringent; wall up to 0.3 µm thick; hilar appendix gradual; ornamentation small, discrete warts or very slender ridges generally longitudinally oriented.

Commentary: Marr (in Marr and Stuntz, 1973) rightly drew attention to fruitbody similarity between *R. vinosimaculans* and *R. xanthosperma* (Pk.) Corner. Both show pale yellow branches and yellow apices, and both produce long spores. *Ramaria xanthosperma* is clampless, while *R. vinosimaculans* produces clamps, so the two are easily separated microscopically. The former seems restricted to eastern North America (Petersen, 1985) while *R. vinosimaculans* fruits in western coniferous forests.

Ramaria vinosimaculans apparently fruits in early summer and again in autumn, although Marr saw only autumnal material. No differences in morphology (either macro- or micro-) can be detected in fruitbodies from the two time periods, but one specimen (TENN 45933) showed significant macrochemical reactivity (FCL, GUA, ANO, ANW = positive; IKI, NOH = negative). Marr reported weak reactivity for the species, and my other collections confirm his conclusion. The single specimen thus far represents an anomaly.

The maroon stains are present on fruitbody bases before picking or handling. When fruitbodies are carefully pried from the substrate with no manual or implement contact, the stains are already present. Moreover, the stains are not enhanced by handling or chaffing, but in old age suffuse upward, rarely to involve almost the entire fruitbody. Normally, however, the stains are ill-defined spots and streaks on the stipe, not widespread as in *R. sanguinea*.

Spore ornamentation is difficult to discern, even with aniline blue stain. Many spores show small, low, discrete warts, but some exhibit very slender, moniliform ridges in a generally longitudinal orientation. The latter configuration is reminiscent of striate ornamentation, but the warty configuration is very similar to that of *R. xanthosperma*. "Giant" spores are also common in some specimens (notably Scates no. 609). Such spores are up to 18 µm long, but of usual width. These spores were not counted in calculating the statistics above.

Fruitbodies of *R. vinosimaculans* are commonly eaten along with other spring species, and are considered choice by some mycophagists.

Specimens examined: Idaho: all Kootenai Co., Canfield Mt., 20.vi.76, coll. CS, no. 45765 (TENN); 7.vi.84, coll. E. Coulter, no. 45748 (TENN); Blue Creek, 13.vi.70, Scates no. 609, no. 46646 (TENN); Coeur d'Alene Mt., 12.vi.71, Scates no. 1518, no. 47601 (TENN); Canfield Mt., 21.vi.70, Scates no. 635, no. 47565 (TENN); Hayden Lake, 1.vi.75, Scates no. 3347, no. 47609 (TENN); Fourth of July Canyon, 7.vi.70, Scates no. 589, no. 47584 (TENN); Hayden Lake, 1.vi.74, Scates no. 3079, no. 47543 (TENN); same location, 15.vi.70, Scates no. 621, no. 47563 (TENN); Spirit Lake, 12.vi.72, Scates no. 1911, no. 47610 (TENN); vic. Rathdrum, 4.vi.72, Scates no. 1887, no. 47595 (TENN); Canfield Mt., 8.vi.71, Scates nos. 1489 (TENN no. 47593), 1490 (TENN no. 47580). Oregon: Mt. Hood Nat. Forest, vic. Government Camp, 17.x.84, coll. Scates & T. Pearson, no. 45933 (TENN); location unknown, 21.x.84, coll. Portland Mycological Society, no. 45903 (TENN).

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A NEW SPECIES OF THE GENUS DICTYOPHORA FROM CHINA

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ABSTRACT

A new species, *Dictyophora echinovolvata* Zang, Zheng, et Hu, is described and discussed. It was collected from Prov. Hunan and Prov. Guizhou (Kweichow), China. The type specimen of the new species is deposited in the herbarium of Cryptogams, Kunming Institute of Botany, Academia Sinica, Kunming (HKAS).

漢文摘要

最近在中國的湖南省會同縣和貴州省天柱縣先後在針闊温交林下發現竹蓀屬的一新種，即棘托竹蓀 *Dictyophora echinovolvata* Zang, Zheng, et Hu, 其形成子實體的最適温度，是 30-35° C. 該菌味美可口且易於培養. 模式標本存中國科學院昆明植物研究所隱花植物標本館

本文撰稿人 臧穆、曽德容、胡仲賢.

For thousands of years, the Chinese have prized a variety of mushrooms species for their beneficial properties. Several species of the genus *Dictyophora* are used as food. It is now known that *Dictyophora indusiata* (Vent. : Pers.) Desv. and *Dictyophora rubrovolvata* Zang, Liu, et Ji are presently under cultivation. They rank above many vegetables in protein content, and have significant levels of vitamins B and C, and are low in fat (Stamets & Chilton, 1983; Zang & Ji, 1984). Recently a new species, *Dictyophora echinovolvata* Zang, Zheng, et Hu, was collected from Hunan and Guizhou Provinces. It is certified to be a delicious fungus.

Dictyophora echinovolvata Zang, Zheng, et Hu, sp. nov. (Figs. 1-4).

Non *Dictyophora echinata* P. Henn. & Nyman, Monsunia **1:** 22. 1900.

Basidiocarpus solitarius vel gregarius. Pileo conico vel campanulato, 2.5–3.5 cm longo, 2.5–3.0 cm lato, superfacie reticulato, apice truncato vel annulato, in centro uniperforato, ad materiam sporiferam olivaceam vel brunneo-atrem. Hyphae in plectenchymate irregularies, ramae. Receptaculum album, cylindricum, fragile, alveolare, cavum, 9–15 cm longum, 2–3 cm latum. Ad parietem bistrato cavernularum aeriarum. Indusium album, fragile, campanulatum, membranaceum, reticulatum, 8–10 cm longum, 4–7 cm latum. Peridium album, brunneolum, 2.5–4.0 cm longum, 2.5–3.5 cm latum, echinulatum, rhizinis numerosis. Basidia 6–8 x 2.5–3.5 µm, clavata, 4-6-sporigera. Basidiosporae anguste ellipticae, levigatae, strictae vel arcuatae, 3–4 x 1.3–2.0 µm, hyalinae vel olivaceo-hyalinae, in solutione KOH flavide, in solutione Melzeri brunneolae.

Habitat in sylvis humidis praecipue quercinis et pinetis.

CHINA: Guan Ping village, Hui Tong County, Prov. Hunan, 15 vii 1986, Hu & Zheng *1*, HKAS 18911 (Holotypus); Su Xi village, Hui Tong County, Prov. Hunan, 16 viii 1986, Hu & Zheng *3*, HKAS 20206; Tian Zhu County, Prov. Guizhou, in damp woods, especially of *Quercus*, 20 viii 1987, S. M. Su *40*, HKAS 20237.

Expanded basidiocarp consisting of a gelatinous volva, an elongated receptacle, a pileus, and an indusium. Basidiocarps solitary or gregarius. Pileus campanulate, 2.5–3.5 cm long, 2.5–3.0 cm broad, obscurely rugose-reticulate, the reticulations being even and with rounded edges, the plectenchymatous hyphae irregular and branched, olivaceous brown, dark brown, but whitish-yellow when the gleba is removed, apex

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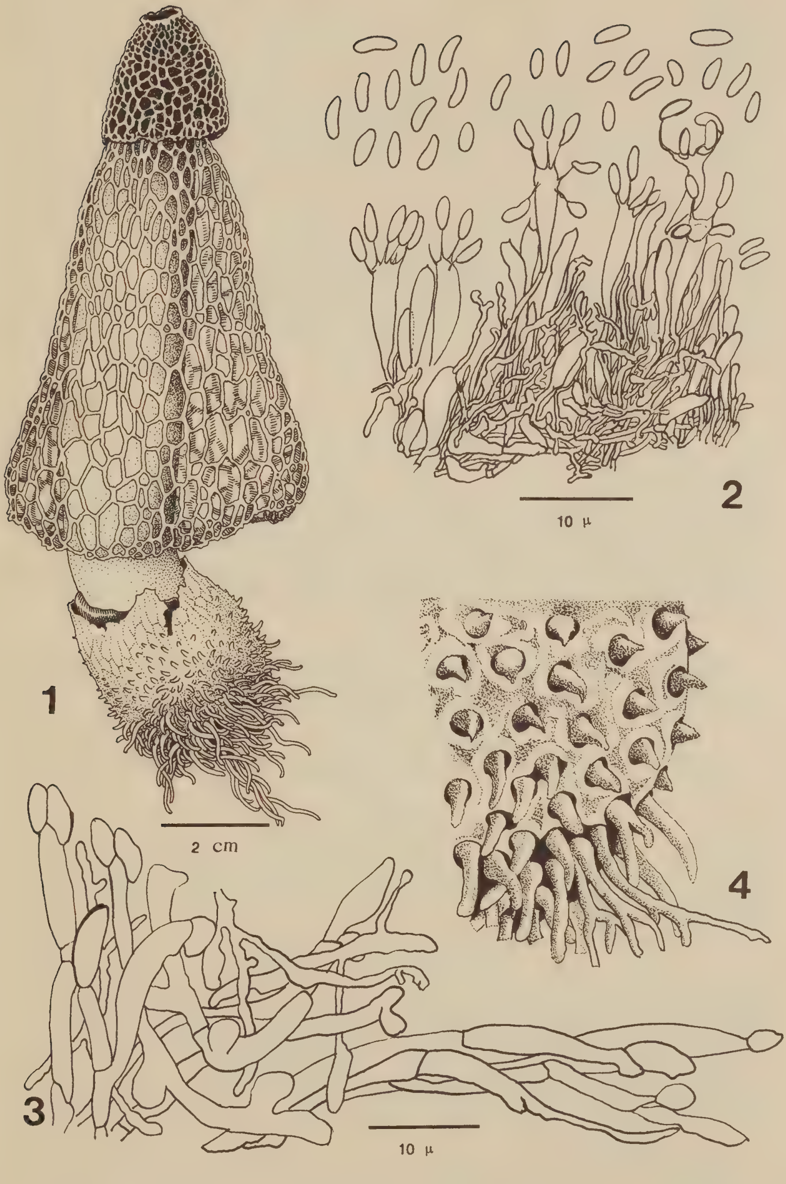
Figs. 1–4. *Dictyophora echinovolvata* Zang, Zheng, et Hu (HKAS 18911, 20237). 1. Habit sketch of basidiocarp (del. Zheng Xiao-lian). 2. Basidia, basidiospores, and hymenial projections. 3. Plectenchymatous hyphae. 4. A part of volva.


1
2 cm
2
10 µ
4
3
10 µ

perforate, collar raised and distinct. Receptacle cylindrical or fusiform, to 9–15 cm tall, 2–3 cm diam, whitish, hollow, wall usually of two layers of small chambers. Indusium coarsely latticed, white, pendant to near the volva, apertures large and polygonal. Basidia cylindrical or clavate, 6–8 x 2.5–3.5 µm, 4–6-spored. Spore mass olivaceous, not noticeably foetid. Spores irregular, mostly obovate-ellipsoid, subclavate, reniform, smooth, brownish-green or olivaceous, straight or curved, 3–4 x 1.3–2.0 µm, color near pale yellow in KOH solution, more or less pale brown in Melzer's Reagent. Volvae appear as globose or obovate bodies, 2–3 x 2.0–2.5 cm, whitish or pale brown, covered with mycelioid, echinulate projections, partially buried in the substratum and attached to it by numerous, strongly branching, basal rhizomorphs.

The species is close to *Dictyophora indusiata* but may be distinguished from it by its smaller overall size, smaller spores (3–4 x 1.3–2.0 µm) and the thinner receptacle usually of two layers of small chambers in cross section, not three layers as in *D. indusiata*. Moreover, the surface of the volva of *D. echinovolvata* is always covered with mycelioid projections (Burk, 1980; Cunningham, 1979).

In addition, this species is possibly thermophilic. It has a maximum for basidiocarp growth of 30–35° C or above.

Habit: In damp woods, especially of *Quercus* and *Pinus*.

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We thank Prof. R. P. Korf (Cornell University) for advice and review of the manuscript.

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SEE ERRATA

MYCOTAXON

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The Scutellinia Battle; The Lost, Missing and Dead.

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SUMMARY

Of 271 epithets considered in a monographic treatment of the genus **Scutellinia**, 46 are accepted and 82 are taxonomic synonyms, while altogether 144 "species" are "lost", imperfectly known or excluded on account of taxonomical or nomenclatural reasons. The status of these 144 epithets is surveyed and the following new combinations are proposed:

Paratrichophaea albescens (Diss. & Raitv.) T. Schum., **Parascutellinia arctespora** (Cooke & Phill.) T. Schum., **Trichophaea hybrida** (Sow.) T. Schum., **Melastiza laeticolor** (Karst.) T. Schum., **Pseudombrophila luteopallens** (Nyl.) T. Schum., **Aleuria phlyctispora** (Lepr. & Mont. in Mont.) T. Schum. and **Wilcoxina sequoia** (Phill.) T. Schum.

During my studies for a forthcoming monograph of the genus *Scutellinia* [Pyronemataceae] (Schumacher 1988), the taxonomy and nomenclature of 271 epithets which have been referred to *Scutellinia*, or which have been suspected by me or others as possibly belonging there, have been considered. Of these, 144 epithets are excluded from the genus of taxonomical or nomenclatural reasons, or as a result of insufficient and inadequate material extant for conclusive determinations. Many imperfectly known taxa may be reinstated when good material becomes available. In the following outline of these 'species' many are either accepted in generic placements already made by other authors, or assigned to other genera of the Pyronemataceae, or they are treated as unacceptable for nomenclatural reasons. The current use binominals that are accepted by me are indicated by the use of capital letters.

abundans, *Scutellinia abundans* (Karst.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza abundans Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:124. 1869.

≡ TRICHOPHAEA ABUNDANS (Karst.) Boud., Hist. Class. discom. d'Eur. 61. 1907.

acerina, *Lachnea acerina* Vel., Mon. Discom. Boh. 1: 306. 1934.

Nomenclatural type: PRM 150960, selected by Svrcek (1971).

The lectotype specimen has not been available for an examination. According to Svrcek (1971,1979), this is a white variety of *S. cervorum* (= *S. crinita*).

adusta, *Scutellinia adusta* (Schulz.) O. Kuntze, Rev. Gen. Pl. 3:520. 1898. ≡ Peziza adusta Schulz., Verh. Zool.-Bot. Wien 16:62. 1866.

= URNULA CRATERIUM (Schw.) Fries, Nova Acta Soc. Sci. Upsal. III (1): 122. 1851.

The original description suggests *Urnula*, and Boudier and Seaver (1928) are probably correct in referring this taxon to *U. craterium*.

affinis, *Scutellinia affinis* (Sacc.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Lachnea affinis Sacc., Michelia 2: 38. 1880. ≡ Trichophaea affinis (Sacc.) Boud., Hist. Class. discom. d'Eur. 61. 1907.

The stated characters, i.e. small ochraceous apothecia with scattered, white hairs, are not indicative of *Scutellinia*, and it can safely be excluded from this genus. Boudier (1907) referred it to *Trichophaea*. Neither Rehm (1896) nor Seaver (1928) adopted this taxon.

albescens, *Cheilymenia albescens* Diss. et Raitv., Eesti NSV Tead. Akad. Toirnet., 22,Biol. no. 2:125. 1973.

≡ PARATRICHOPHAEA ALBESCENS (Diss. et Raitv.) T. Schum. comb. nov. [Basionym: Cheilymenia albescens Diss. & Raitv., Eesti NSV Tead. Akad. Toirnet., 22, Biol. no. 2: 125. 1973] = ?Paratrichophaea macrocystis Trigaux, Docums. mycol. 16 (61):6. 1985.

Specimens examined: U.S.S.R. RPSS. Kirghiziae. Tianshan interior, Montes Moldotau apud vallim fluvii Karatal, ad lignum dejectum 29.7.1967 leg. A. et T.

Raitviir (TAA 44519 – holotype). NORWAY. Oppland. Søndre Land. Finnli, on moist soils 6.9.1986 E. Johannesen (O).

Obviously, this is a *Paratrichophaea* species, as recently circumscribed by Trigaux (1985), based on specimens from France. The features of a pale hymenium, long, stiff, brownish, basally furcate rooting hairs in combination with hairs originating from an outermost bulbous ectal cell, straight paraphyses little inflated above, and smooth eguttulate ascospores led Trigaux (1985) to erect a new genus to accommodate her specimens. *C. albescens* was, with reservations, referred to *Cheilymenia* by Dissing & Raitviir (1973). The raised margin of angular cells in rows is reminiscent of what is observed in the genus *Trichophaeopsis* Korf & Erb. However, this latter genus has among others different hairs. I have been unable to observe a loosening of the perispore in lactic acid such as reported by Dissing & Raitviir (1973). Since *C. albescens* is better accommodated in the new genus *Paratrichophaea*, the necessary new combination is proposed. *Tricharina bisetosa* Thind & Kaushal [= *Cheilymenia bisetosa* sensu Yang & Korf (1985)] may also prove to be a younger synonym (cf. Thind & Kaushal 1979).

albobadia, *Scutellinia albobadia* (Saut.) O. Kuntze (ut 'alboflava'), Rev. Gen. Pl. 2:869. 1891. ≡ Peziza albobadia Saut., Flora 28: 133. 1845.

The description of a white ascocarp with short, brownish hairs is scarcely indicative of a *Scutellinia* species. The type specimen was revised by Winter (1881) and Keissler (1917). The latter author regarded it as a variety of or closely related species to *Trichophaea woolhopeia*. It can safely be excluded from *Scutellinia*.

alboflava, [*Scutellinia alboflava* (Saut.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891]

This is based on Saccardo's (1889) misspelling of *Peziza albobadia* Saut., carelessly adopted by Kuntze (1891) without checking the original publication.

albospadicea, *Scutellinia albospadicea* (Grev.) Lamb, Fl. mycol. Belge, Suppl. 1:300. 1887. ≡ Peziza albospadicea Grev., Fl. Edin. 420.1824.

≡ TRICHOPHAEA ALBOSPADICEA (Grev.) Boud., Hist. Class. discom. d'Eur.61.1907.

alnea, [*Scutellinia alnea* (Vel.) Svr., Sb. Nár. muz. Praze 32B (2-4): 153, 1979. – nomen invalidum] ≡ Lachnea scutellata (L.) Lamb. var. alnea Vel., Ceske houby

874. 1922. ≡ Lachnea hirta (Schum.) Gill. var. alnea (Vel.) Vel., Mon. Discom. Boh. 1: 303. 1934.

Nomenclatural type: PRM 147287, selected by Svrcek (1971).

According to Svrcek (1971,1979) this is a *Scutellinia* species. Svrcek (1979) intended to give it specific rank. However, the proposed transfer to *Scutellinia* was not in accordance with the Code (article 33) and is invalid. The type specimen of this species has not been available from Prague.

alpina, *Scutellinia alpina* (Fuck.) O. Kuntze, Rev. Gen. Pl. 2:869.1891. ≡ Humaria alpina Fuck., Jb. nassau. Ver. Naturk. 29/30:32.1875.

= CHEILYMENIA CILIATA (Bull.) Maas G., Proc. Kon. Ned. Akad. Wetens.-Amsterd., ser. C, 72: 313. 1969.

Specimens examined: Austria. Fungi rhen. no 2687, sub nomen *Humaria alpina* (S,K – isotypes).

My observations concur with Rifai (1968), who referred this specimen to *Cheilymenia stercorea* (Pers.) Boud. ss. auct. [= *C. ciliata* fide Maas Geesteranus (1969)].

anemone, *Scutellinia anemone* (Quél.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza anemone Quél., C.R. Assoc. Fr. Av. Sc. 13:284.1884.

The original description and figures (Quélet 1884) seem to preclude assignment to *Scutellinia*. Boudier (1907) referred it to his broad concept of *Pustularia* (= *Tarzetta* (Cooke) Lamb.). On the basis of the description, cf. *Parascutellinia* Svrcek or *Rhodoscypha* Diss. & Siv.

antarctica, *Lachnea antarctica* P. Henn. in Drygalski, Deut. Südp. Exped. 8, Bot., 1: 8. 1906.

I have been unable to locate type or authentic collections of this species. On the basis of the diagnosis, it may well represent a *Scutellinia* or a *Cheilymenia* species.

antarctica f., *Scutellinia umbrata* (Fr.) Lamb. f. *antarctica* (Rehm) Gamundí, Contrib. Cient. Univ. Buenos Aires, Bot. 1:77. 1956. ≡ Lachnea umbrata (Fr.) Rehm f. antarctica Rehm, Bih. K. Sv. Vet.-Akad. Handl. 25, Afd. III, (6): 19. 1899. ≡ Ciliaria umbrata (Fr.) Boud. var. antarctica (Rehm) Boud., Hist. Class. discom. d'Eur. 61. 1907.

Nomenclatural type: Argentina. Patagonia. Punta Arenas 22.2.1895, A.P. Dusén no 2, in paludosis (only Rehm's description and drawing of the type specimen is left in S).

According to the original description (Rehm 1899), this taxon might well represent a *Scutellinia* species (see discussion of *Scutellinia umbrata*). There is apparently no material left to provide a conclusive determination.

arctespora, *Scutellinia arctespora* (Cooke et Phill.) Lamb., Fl. mycol. Belge, Suppl. 1:300. 1887. ≡ Peziza arctespora Cooke et Phill., Grevillea 9:104. 1881. ≡ Ciliaria arctespora (Cooke et Phill.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ PARASCUTELLINIA ARCTESPORA (Cooke et Phill.) T. Schum. comb. nov. [Basionym: Peziza arctespora Cooke et Phill., Grevillea 9:104. 1881] = Parascutellinia violacea (Vel.) Svr., Ceská Myk. 29:129. 1975.

Specimen examined: Libert no 888 sub nomen *Peziza(Scutellinia) arctespora* (K -ex Phillips-holotype).

The above cited type specimen represents *Parascutellinia violacea* (Vel.) Svr. as currently circumscribed (Svrcek 1975). Since *Peziza arctespora* provides an older name, the necessary new combination is proposed.

arenicola, *Scutellinia arenicola* (Lév.) O. Kuntze, Rev. Gen. Pl. 2:869.1891. ≡ Peziza arenicola Lév., Ann. Sci. Nat. III, 9: 140. 1848.

≡ GEOPORA ARENICOLA (Lév.) Kers, Sv. Bot. Tidskr. 68: 345. 1974.

arenosa, *Scutellinia arenosa* (Fuck.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Humaria arenosa Fuck., Jb. nassau. Ver. Naturk. 23/24: 321. 1870. ≡ Geopora arenosa (Fuck.) Ahmad, Monogr. Biol. Soc. Pakistan 7:176. 1978.

= GEOPORA ARENICOLA (Lév.) Kers, Sv. Bot. Tidskr. 68: 345. 1974.

Specimen examined: Germany. Fungi rhen. no. 1212, sub nomen *Peziza arenosa* Fuck. (S -isotype).

This is *G. arenicola*, such as delimited by Kers (1974) and Schumacher (1979).

arenosa f., *Lachnea umbrorum* (Fr.) Gill. f. *arenosa* (Vel.) Svr., Sb. Nár. muz. Praze IV B (6): 60. 1949 ('1948'). [≡ Scutellinia arenosa (Vel.) Le Gal, Bull. Soc.

mycol. Fr. 82: 643. 1966. – nomen illegit. - later homonym of S. arenosa (Fuck.) O. Kuntze] [≡ Lachnea arenosa Vel., Mon. Discom. Boh. 1: 306. 1934. – nomen illegit. – later homonym of L. arenosa (Fuck.) Sacc.]

Nomenclatural type: PRM no. 151427, lectotype selected by Le Gal (1966b).

I requested the type from Prague, but have received no material. The type specimen was studied by Le Gal (1966b), Svrcek (1971) and Moravec (1974). Svrcek (1971) referred it to *S. hrabanovi*, a taxon which has been restudied by me and was found conspecific with *S. kerguelensis*. The description and figures provided by Le Gal (1966b), partly based on the type and partly on specimens from Poland, point to *S. patagonica*, as does the concept of *S. arenosa* presented by Svrcek (1971, 1979), Moravec (1974) and Kullman (1982). According to Moravec (1974) Le Gal's concept of *S. arenosa* represents a mixture of species.

articulata, *Scutellinia articulata* (Karst.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza articulata Karst., Syn. Peziz. Ascob. fenn. 13. 1861.

The description of a minute, white ascocarp clothed with hairs is scarcely indicative of a *Scutellinia* species. Boudier (1907) referred it to *Tricharia* (=*Tricharina* Eckbl.), while Yang and Korf (1985) argued for its doubtful position in this genus due to the unusual habitat (amongst leaves of *Polytrichum commune)* for that genus. Based on the description, it is here excluded from *Scutellinia*.

ascoboloides, *Scutellinia ascoboloides* (Bert. ex Mont.) S.C. Teng, Chung-kuo Ti Chen-chun 763. 1964. ≡ Peziza ascoboloides Bert. ex Mont., Ann. Sci. Nat. (Bot.) II, 8:363. 1837.

= CHEILYMENIA THELEBOLOIDES (Alb. et Schw.) Boud., Hist. Class Discom. d'Eur. 62. 1907.

Specimen examined: Chile. In vinaceis decompositis, Rancagua sin. dat. Bertero (K-ex Montagne- holotype).

The specimen is referable to *Cheilymenia*. Rifai (1968) considered *P. ascoboloides* to be a taxonomic synonym of *C. theleboloides*, and I accept Rifai's synonymy.

asperior, *Scutellinia asperior* (Nyl.) Dennis, Kew Bull. 4:571. 1956 ('1955') ≡ Peziza asperior Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:21. 1869. ≡ Ciliaria asperior (Nyl.) Boud., Icon. Myc. 2, pl. 377.

≡ RAMSBOTTOMIA ASPERIOR (Nyl.) Benkert et T. Schum., Agarica 6 (12):35. 1985.

Specimens examined: Finland. Ostrobottnia australis. Jalasjärvi, ad terram in marg. rivuli, 25. 7. 1859 P.A. Karsten sub nomen *Peziza umbrosa* Fr. (H – ex. herb. Karsten, syntype of *Peziza asperior* Nyl.). Jalasjärvi Juli 1864 – 1868 P.A. Karsten [H – ex herb. Nylander, sub nomen *P. asperior* (syntype)]. Ostrobottnia borealis. Rovaniemi 5.8.1863 leg. M. Brenner, ad presbyterium [H – ex herb. Nylander, sub nomen *P. asperior* (lectotype of *P. asperior*)], Rovaniemi 9.8.1864 leg. M. Brenner [H – ex herb. Nylander, sub nomen *P. asperior* (syntype)].

As shown by Benkert and Schumacher (1985), *Peziza asperior* belongs in the *Lamprospora crec'hqueraultii* – complex, now retained in the genus *Ramsbottomia* Buckley.

asperula, *Melastiza asperula* Spooner, Trans. Br. mycol. Soc. 76:288. 1981.

= MELASTIZA LAETICOLOR (Karst.) T. Schum., Mycotaxon 33:168. 1988.

Specimen examined: England. Devon. Dartmoor, Fernworthy forest 1. November 1976 N. W. Legon (K-holotype).

This is a taxonomic synonym of *Peziza laeticolor* (= *M. laeticolor*) Karst. I agree with Spooner (1981) that of the existing genera of the Pyronemataceae, *Melastiza* is the most appropriate place to accommodate this species.

aurantia, *Scutellinia aurantia* (Clem.) Waraitch, Trans. Br. mycol. Soc. 68: 37. 1977.

≡ Sepultaria aurantia Clem., Bot. Surv. Nebraska. 4: 12. 1896.

I have been unable to locate type or authentic collections of this species. Waraitch (1977) combined Clements' name in *Scutellinia*, apparently without having had access to authentic material. Seaver (1928) treated it in *Sepultaria* (= *Geopora*). The long, narrow and partly flexuous hairs, as described in the protologue, seem to preclude assignment to *Scutellinia*. On the basis of the description, cf. *Tricharina* or *Geopora*.

aurantiaca f., *Scutellinia barlae* (Boud.) Maire, f. *aurantiaca* Donad., Docums. mycol. 13 (49): 29. 1983.

Nomenclatural type: France. Mazaugues (Var) /6.1978 J.-C. Donadini no 231-78 (herb. priv.)

The type specimen has not been available on loan. The original description suggests *S. barlae*.

aurantiopsis, *Scutellinia aurantiopsis* (Ell.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza aurantiopsis Ell., Bull. Torr. Bot. Club 9:18. 1882.

≡ WOLFINA AURANTIOPSIS (Ell.) Eckbl., Nytt Mag. Bot. 15: 126. 1968.

boudieri, *Lachnea boudieri* Höhn. ex Rehm, Ann. Mycol. 7: 298. 1910 [non L. boudieri (Torr.) Sacc. et Trott., Syll. fung. 22, Suppl. 630. 1913, = Lachnea austriaca Sacc. et Trott., Syll. fung. 22, Suppl. 634. 1913.]

≡ MELASTIZA BOUDIERI (Höhn. ex Rehm) Le Gal, Bull. Soc. mycol. Fr. 74: 152. 1958.

Specimen examined: Austria. Auf Lehmboden bei Kalksberg im Wiener Wald (Österreich) /10.1909 von Höhnel, Rehm: Ascomyceten no 1876 (K-isotype).

I concur with Le Gal (1958) in placing this species in the genus *Melastiza.* It is close to *M. flavorubens* (Rehm) Pfister & Korf.

brachyacantha f., [*Scutellinia trechispora* (Berk. et Br.) Lamb. f. *brachyacantha* Le Gal, Bull. Soc. mycol. Fr. 87: 437. 1972 ('1971') - nomen nudum].

This taxon was introduced without designation of a nomenclatural type (Le Gal 1972) and is invalid according to Article 37 of ICBN. Material in herb. O. annotated and referred to this form by Le Gal represents three different species, viz. *S. minor, S. patagonica* and *S. hyperborea*.

brasiliensis, *Scutellinia brasiliensis* (Wint.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza brasiliensis Wint., Grevillea 15: 91. 1887.

No authentic material has been located. The description suggests *Scutellinia*, and the recorded characters together with phytogeographic area makes one think of *S. blumenaviensis*. If they are conspecific, the name *S. brasiliensis* will have priority, having been published 15 years prior to *S. blumenaviensis*.

brunnea, *Scutellinia brunnea* (Alb. et Schw.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza brunnea Alb. et Schw., Consp. fung. 317. 1805. ≡ Peziza brunnea Alb. et Schw.:Fr., Syst. mycol. 2:83. 1822. ≡ Ciliaria brunnea (Alb. et Schw.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ SPHAEROSPORELLA BRUNNEA (Alb. et Schw.) Svr. & Kub., Ceská Myk. 15: 65. 1961.

bulbopilosa f., *Scutellinia scutellata* (L.) Lamb. f. *bulbopilosa* Svr., Sb. Nár. muz. Praze 4 B (6): 54. 1949 ('1948').

Nomenclatural type: Czechoslovakia. Slovenia, prope Turna, Bodvou, ad terram solo calcareo /10.1934 leg. Pilát (PRM – holotype).

The type specimen has not been available from Prague.

carneorufa, *Scutellinia carneorufa* (Mart.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza carneorufa Mart., Fl. crypt. Erlang. 464. 1817. ≡ Peziza carneorufa Mart.:Fr., Syst. mycol. 2:85. 1822.

Fries (1822) adopted the name in subtribe Ciliares of *Peziza* tribe *Sarcoscypha*. Quélet (1886b) referred it to *Lachnea* (Fr.) Gill. keeping it apart from the true *Scutellinia*, which was referred to *Humaria* (Fr.) Fuck. tribe *Ciliaria* Quél. Saccardo (1889) put it in subgenus *Scutellinia* Cooke (= *Ciliaria* Quél.) of *Lachnea*. Boudier (1907) referred it to *Neottiella*. The description of a reddish hymenium with rigid, pale hairs on the receptacular surface might possibly fit *Scutellinia* (or *Parascutellinia*) also. However, there seems to be no authentic collection left for examination.

carneosanguinea, *Scutellinia carneosanguinea* (Fuck.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Humaria carneosanguinea Fuck., Jb. nassau. Ver. Naturk. 23/24:323. 1870. ≡ Ciliaria carneosanguinea (Fuck.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ PARASCUTELLINIA CARNEOSANGUINEA (Fuck.) T. Schum., Norw. J. Bot. 26: 62. 1979.

Specimens examined: Germany. Nassau, sin.dat., sub nomen *Lachnea carneosanguinea*, auf schlammigem Boden, am Rheinufer, F. rhen. no 2288 (S-lectotype, K-isolectotype).

Authentic material of this species was recently redescribed by Schumacher (1979).

caudata, *Ciliaria caudata* Buckley, Trans. Brit. Myc. Soc. 8:45. 1923.

I have not been able to locate type or authentic collections of this species. There is no material in K or BM. The description (Buckley 1923) suggests *Scutellinia*, and in the original description the taxon is compared with *S. umbrorum*.

chaetoloma, – *Scutellinia chaetoloma* Clem., Bull. Torr. Bot. Club 30:89. 1903.

≡ TRICHOPHAEA HYBRIDA (Sow.).T. Schum. Mycotaxon 33:166. 1988.

Specimen examined: USA. Colorado. Jack Brook 2500 m, 22.8.1904 Crypt. Form. Color. no 118, on soil (NEB - topotype).

This taxon was erected based on material collected in August 1899. The above cited material is a topotype distributed by F.E. and E.S. Clements in their 'Cryptogamae Formationum Coloradensium'. The specimen belongs in the *T. hybrida* (= *T. gregaria)* – complex.

coccinea, [*Scutellinia coccinea* Remy, Bull. Soc. mycol. Fr. 80:584. 1964 - nomen invalidum]

The name was published without explicitly indicating a nomenclatural type. According to article 37 of ICBN the name has to be rejected. The description of Remy (1964) undoubtedly suggests *Scutellinia.*

coelopus, *Scutellinia coelopus* (Mont. in C. Gay) O. Kuntze, Rev. Gen. Pl. 3: 520. 1898. ≡ Peziza coelopus Mont. in C. Gay, Historia Fisica y Politica de Chile. Botànica, 7: 398. 1852.

≡ PLECTANIA COELOPUS (Mont. in C. Gay) Sacc., Syll. fung. 8: 164. 1889.

coerulea, *Scutellinia coerulea* (Bolt.) Lamb., Fl. mycol. Belge, Suppl.1:301. 1887. ≡ Peziza coerulea Bolt., Hist. fung. t. 108. 1789. ≡ Peziza coerulea Bolt.:Fr., Syst. mycol. 2:86. 1822.

Fries (1822) placed this taxon in subtribe *Ciliares* of *Peziza* tribe *Sarcoscypha* on the basis of the dark, rigid hairs. However, the bluish white colour of the hymenium is not indicative of *Scutellinia.* The diagnosis suggests *Trichophaea* sensu lato.

confusa, *Ciliaria confusa* (Cooke) Boud., Hist. Class. discom. d'Eur. 62. 1907. ≡ Peziza confusa Cooke, Bull. Buffalo Soc. Nat. Sci. 2:291. 1875.

≡ SPHAEROSPORELLA HINNULEA (Berk. et Br.) Rifai, Verh. Kon. Nederl. Akad. van Wetensch., Afd. Natuurk., Tweede Reeks, 57 (3):100. 1968.

contorta, *Lachnea contorta* Masse et Crossl., The Naturalist, Yorkshire 1901:182. ≡ Ciliaria contorta (Masse et Crossl.) Boud., Hist. Class. discom. d'Eur. 61. 1907.

= MELASTIZA spec.

Specimen examined: England. Selby. Med West Yorkshire, leg. Massée. sin. dat. (K - lectotype here selected).

This is an immature *Melastiza* species, probably *M. chateri* (W.G. Smith) Boud.

coprinaria, *Scutellinia coprinaria* (Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza coprinaria Cooke, Grevillea 4: 91. 1875.

≡ CHEILYMENIA COPRINARIA (Cooke) Boud., Hist. Class. discom. d'Eur. 63. 1907.

coprinella, *Scutellinia coprinella* (Quél. in Sacc.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Ciliaria coprinaria Quél., C.R. Assoc. Fr. Av. Sc. 11:20. 1882. ≡ Lachnea coprinella Quél. in Sacc., Syll. fung. 8: 175. 1889.[- a name change] ≡ Cheilymenia coprinella (Quel. in Sacc.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

On the basis of orange-red disc, brownish-white hairs, and its coprophilous habit, cf. *Cheilymenia* (Quélet 1882).

coprogena, *Scutellinia coprogena* (Berk. & Br.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza (Lachnea) coprogena Berk. & Br., Trans. Linn. Soc. Lond. II, 2: 69. 1882.

≡ CHEILYMENIA COPROGENA (Berk. & Br.) Rifai, Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk., Tweede Reeks, 57 (3):136. 1968.

cretea, *Scutellinia cretea* (Cooke) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza cretea Cooke, Trans. Bot. Soc. Edinburgh 13: 46. 1877.

≡ TRICHARINA PRAECOX (Karst.) Dennis var. CRETEA (Cooke) Yang & Korf, Mycotaxon 24:505. 1985.

crispata, *Scutellinia crispata* (Berk. et Curt. in Berk.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza crispata Berk. et Curt. in Berk., J. Linn. Soc. London 10: 367. 1868.

≡ PHILLIPSIA CRISPATA (Berk. et Curt. in Berk.) Le Gal, Prodr. fl. mycol. Madag. 4:262. 1953.

dalmeniensis, *Scutellinia dalmeniensis* (Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza dalmeniensis Cooke, Grevillea 3: 66. 1874.

≡ CHEILYMENIA DALMENIENSIS (Cooke) Boud., Hist. Class. discom. d'Eur. 63. 1907.

Specimen examined: Scotland. West Lothian. Dalmeny, on the ground August 1871 (K-ex Berkeley – holotype).

This is a member of the genus *Cheilymenia*. As is clear from Cooke's annotations on specimens in the Kew Herbarium, he confused the Scottish species with that from Australia and New Zealand, the latter growing on dung. The collections on dung were referred to *C. coprinaria* by Rifai (1968). *C. dalmeniensis* was regarded a synonym of *Cheilymenia vitellina* by Dennis (1960) and Denison (1964).

delectans, *Humaria delectans* Starb., Bot. Not., p. 211. 1898.

= GEOPYXIS MAJALIS (Fr.) Sacc, Syll. fung. 8: 72. 1889.

Specimens examined: Sweden. Upland. Knifsta, 11/6 et 13/7 1895. K. Starbäck (S - ex Vestergren, Micromycetes rariores selecti no. 51 – isotype), /8-1895 K. Starbäck (S – Fungi exsiccati no 34).

The specimens belong to *G. majalis* as circumscribed by Eckblad (1968). The excipulum consists of two layers, the outermost layer with globose to angular cells of even size. The ascocarps are pinkish (dried), hairless and to 1.5 cm in diam. Paraphyses are thin and enlarged and irregular at the tips; ascospores 13.2-15.6 x 7.0-8.3 μm, ellipsoid, smooth, without internal guttules. The species has been referred to *Aleuria* by Boudier (1907) and to *Kotlabaea* by Svrcek (1974).

depauperata f., – *Lachnea scutellata* (L.) Gill, f. *depauperata* Møll., Fungi faeroes 2:103. 1958.

Nomenclatural type: Denmark. Faeroes. Strøms. Thorshavn 21.7.1938 F.H. Møller.

I have been advised by Mr. H. Knudsen at the Botanical Museum of Copenhagen (C) that the type specimen has not been preserved in C.

ditricha, *Scutellinia ditricha* (Fr.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza ditricha Fr., Syst. mycol. 2: 83. 1822.

The name seems to be 'lost'. The protologue (Fries 1822) of a pale-coloured ascocarp with light, adnate hairs on the outside seems to preclude assignment to *Scutellinia*. Saccardo (1889) accommodated it in *Lachnea* (Fr.) Gill.

diversicolor, *Scutellinia diversicolor* (Fr.) Lamb., Fl. mycol. Belge, Suppl. 1: 301. 1887. ≡ Peziza diversicolor Fr., Syst. mycol. 2:88. 1822. =?Lasiobolus ciliatus (Schmidt) Boud., Hist. Class. discom. d'Eur. 78. 1907.

The true identity of this taxon is not clear. Rifai (1968) followed Rehm (1896) and Seaver (1928), who placed it in synonymy with *L. ciliatus* based on interpretations and current use of the name by nineteenth-century mycologists.

echinus, *Stereolachnea echinus* Höhn., Ann. Mycol. 15: 353. 1917.

Nomenclatural type: East Germany. Sonntagsberge autumn 1914 leg. P.P. Strasser, 'auf morscher mit *Pionnotes* (?) besetzter Rinde'.

From the original description this is a white-coloured ascocarp with thick-walled, brownish, multiseptate hairs to 210-280 × 30-40 μm and ascospores 'rough' ellipsoid with one or two internal guttules, 22-25 × 12-14 μm. Eckblad (1968), who studied the alleged type specimen located in FH, concluded 'no fungus remains left, but two slides from the type show rooting hairs and ellipsoid, verruculose spores containing two oil-drops, which indicate that it belongs in *Scutellinia* . *Stereolachnea* Höhn., based on *S. echinus* as the only original species, was put in synonymy with *Scutellinia* by Clements and Shear (1931) and Denison (1961), which seem justified by the reexamination of the type by Eckblad cited above.

eclecta, *Peziza eclecta* Berk. et Cooke in Cooke, Grevillea 5:60. 1876.

= CHEILYMENIA THELEBOLOIDES (Alb. et Schw.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

Specimen examined: England. Sibbertoft. sin. dat., on ground, leg. M.J. B (erkeley) (K-ex Cooke- holotype).

This is a *Cheilymenia* species growing on soil. Cooke (1879) treated it as a synonym of *Peziza ascoboloides* Bert. ex Mont. in his 'Mycographia'. Rifai (1968) referred it to *C. theleboloides,* a decision also accepted here.

erecta, *Scutellinia erecta* (Sow.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza erecta Sow., Engl. Fungi t. 369, fig.10, 1802. ≡ Peziza erecta Sow.:Fr., Syst. mycol. 2: 69. 1822.

The name is apparently 'lost'. Fries (1822) placed this taxon in tribe *Humaria* of *Peziza* due to the inconspicuous, pale hairs along the apothecial margin. This, in addition to the description of a minute yellow ascocarp and bryophilous growth, seem to preclude assignment to *Scutellinia*. Boudier (1907) accommodated it in *Cheilymenia*.

fimbriata, *Scutellinia fimbriata* (Quél.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Lachnea fimbriata Quél., Bull. Soc. Bot. Fr. 25: 291. 1879 ('1878').

= TRICHARINA GILVA (Boud. in Cooke) Eckbl., Nytt Mag. Bot. 15:60. 1968 (fide Yang & Korf 1985).

fissilis, *Scutellinia fissilis* (Sacc. et Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza fissilis Sacc. et Cooke, Michelia 2: 257. 1881. ≡ Ciliaria fissilis (Sacc. et Cooke) Boud., Hist. Class. discom. d'Eur. 62. 1907.

Specimen examined: Italy. Patavia, in allis in horto /4.1880 Saccardo (K-holotype).

I have found no apothecial remains in the above cited collection. On the basis of the description, cf. *Geopora*. Boudier (1907) referred it to *Ciliaria,* while Seaver (1928) treated it among the doubtful and excluded species of *Patella.*

flava, *Scutellinia flava* (Fuck.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Humaria flava Fuck., Jb. nassau. Ver. Naturk. 23-24: 322. 1870. ≡ Cheilymenia flava (Fuck.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

The description of a yellowish-brown ascocarp with scattered brownish hairs and eguttulate ascospores seems to preclude assignment to *Scutellinia*. Boudier (1907) is probably right when referring it to *Cheilymenia.*

flavobrunnea, *Scutellinia flavobrunnea* (Richon) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza flavobrunnea Richon, Descr. dess. pl. crypt. 6. 1879.

On the basis of the protologue and figures, cf. *Trichophaea* sensu lato. Boudier (1907) referred it to *Lachnea*. The name was not adopted by Rehm (1896) nor Seaver (1928). Velenovsky (1934) adopted the name and was followed by Svrcek (1949) who used it when recording material from Czechoslovakia, which according to him had ascospores similar to those of *S. scutellata.*

fulvescens, *Scutellinia fulvescens* (Nyl.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza fulvescens Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 20. 1869.

= CHEILYMENIA CILIATA (St. Amans) Maas G., Proc. Kon. Nederl. Akad. Wet.-Amsterdam, Ser. C, 72: 313. 1969.

Specimen examined: Finland. Tavastia australis. Hollola 25.5.1863. J.P. Norrlin 96 (H – holotype).

According to the protologue, the holotype specimen was growing on soil. The material fits *Cheilymenia ciliata* in all details: brownish, multi-stellate hairs, and eguttulate smooth ascospores, 17.1-20.5 x 8.2-9.7 μm. The type specimen gives no additional information as to the substrate; it may also grow on manured soils.

fulvococcinea var., *Peziza hirtococcinea* Phill. et Plowr. var. *fulvococcinea* Phill., Man. Brit. Discom. 212. 1887. ≡ Ciliaria hirtococcinea (Phill. et Plowr.) Boud. var. fulvococcinea (Phill.) Boud., Hist. Class. discom d'Eur. 62. 1907.

Nomenclatural type. England. Wrexham leg. Acton.

I have not been able to locate the type specimen of this taxon. The description suggests *Scutellinia* or *Cheilymenia*.

fuscoatra, *Scutellinia fuscoatra* (Reb.) O. Kuntze, Rev. Gen. Pl. 2: 869.1891. ≡ Peziza fuscoatra Reb., Prodr. Fl. Neom. 315. 1804. ≡ Peziza fuscoatra Reb.: Fr., Syst. mycol. 2: 82. 1822.

The white hymenium and presence of both undulating and rigid hairs (Fries 1822) seems to preclude assignment to *Scutellinia*. Boudier (1907) referred it to *Trichophaea*.

fusicarpa, *Scutellinia fusicarpa* (Ger.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza fusicarpa Ger., Bull. Torr. Bot. Club 4: 64. 1873.

≡ JAFNEA FUSICARPA (Ger.) Korf, Nagoa 7: 5. 1960.

geaster, *Scutellinia geaster* (Berk. et Br.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza geaster Berk. et Br., Ann. Nat. Hist., ser. III, 18: 125. 1866. ≡ Sepultaria geaster (Berk. et Br.) Boud., Hist. Class. discom. d'Eur. 59. 1907.

= ?Geopora arenicola (Lév.) Kers, Sv. Bot. Tidskr. 68:345. 1974.

It is generally accepted that this species belongs in *Sepultaria* (Cooke) Boud. (= *Geopora* Harkness). Seaver (1928) included it in his broad concept of *Sepultaria arenicola* (= *Geopora arenicola* (Lév.) Kers).

gelatinosa, *Scutellinia gelatinosa* S.C. Kaushal et R. Kaushal in Kaushal, S.C., Kaushal, R. & Rawla, G.S., Bibl. Myc. 91:590. 1983.

Nomenclatural type: India. Meghalaya. Mawphlang, in luto stercorato 28.6.1978 Rishi 18022 (PAN).

I requested the type from PAN, but have received no answer to my enquiry. The original description suggests a taxon close to, if not identical with *S. ahmadii*.

gilva, *Scutellinia gilva* (Boud. in Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza gilva Boud. in Cooke, Mycographia 1:240. 1879.

≡ TRICHARINA GILVA (Boud. in Cooke) Eckbl., Nytt Mag. Bot. 15:60. 1968.

glumarum, *Peziza glumarum* Desm., Ann. Sci. Nat. 15: 129. 1841.

≡ CHEILYMENIA GLUMARUM (Desm.) Svr., Ceská Myk. 28: 130. 1974.

Specimen examined: France. Desmaz., Crypt. Fr., Ser 1 (1825-51) no 1054 (1840), labelled *Peziza glumarum,* ad glumas, Vere 1839 (K- isotype).

Based on examination of the type, I agree with Svrcek (1974) in placing this species in *Cheilymenia*.

gregaria, *Scutellinia gregaria* (Rehm in Wint.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Humaria gregaria Rehm in Wint., Flora 55:508. 1872.

= TRICHOPHAEA HYBRIDA (Sow.) T. Schum., Mycotaxon 33:166. 1988.

hainesii, *Scutellinia hainesii* (Ell.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza hainesii Ell., Bull. Torr. Bot. Club 8: 65. 1881.

= JAFNEA SEMITOSTA (Berk. et Curt. ex Berk.) Korf, Nagoa 7: 5. 1960.

hazslinszkia, *Scutellinia hazslinszkia* (Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza hazslinszkia Cooke, Mycographia 1:238. 1879.

The description and figures of an ochraceous ascocarp, compacted hairs, and bipolarly biguttulate ascospores (Cooke 1879), preclude assignment to *Scutellinia*. Boudier (1907) referred it to *Trichophaea*.

hemisphaerica, *Scutellinia hemisphaerica* (Web. in Wigg.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza hemisphaerica Web. in Wigg., Fl. Hols. 105. 1780. ≡ Peziza hemisphaerica Web. in Wigg.: Fr, Syst. mycol. 2:82. 1822.

≡ HUMARIA HEMISPHAERICA (Web. in Wigg.) Fuck., Jb. nassau. Ver. Naturk. 23/24:322. 1870.

heterospora, *Scutellinia heterospora* Clem., Bull. Torr. Bot. Club 30: 90.1903.

Nomenclatural type: U.S.A. Colorado. Minnehaha, August 1899 leg. F.E. Clements.

I have been unable to locate authentic specimens of this taxon. There is no material in NEB or NYS. The diagnosis indicates *Scutellinia*. Seaver (1928) referred it to *Patella umbrorum* (= *S. umbrorum*), and the description of an asperulate spore ornamentation and large-sized, broadly ellipsoid ascospores suggests *S. umbrorum* as the most similar taxon.

hinnulea, *Scutellinia hinnulea* (Berk. et Br.) Dennis, Brit. Cup Fungi 26. 1960. ≡ Peziza hinnulea Berk. et Br., Ann. Mag. Nat. Hist. IV, 7:433. 1871. ≡ Ciliaria hinnulea (Berk. et Br.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ SPHAEROSPORELLA HINNULEA (Berk. et Br.) Rifai, Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk., Tweede Reeks, 57 (3):100. 1968.

hirta, *Scutellinia hirta* (Schum.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza hirta Schum., Enum. Pl. Saell. 2:422. 1803. ≡ Peziza hirta Schum:Fr., Syst. mycol. 2: 84. 1822. = Ciliaria hirta (Schum.) Arnauld, Bull. Soc. mycol. Fr. 9: 112. 1893.

The name has been variously interpreted and should be rejected as a nomen ambiguum, as previously suggested by Seaver (1928) and Schumacher (1979). Le Gal (1966a) adopted the name and selected a neotype from K (Fungi Brit. II, no 187, sub nomen *Peziza scutellata*), in accordance with the interpretation of *Peziza (Sarcoscypha) hirta* made by Cooke (1879). The original description and figures of Schumacher do not indicate a *Scutellinia* species, but rather a member of the genus *Geopora*. Fries (1822) placed *P. hirta* in tribe Sarcoscyphae of series Lachnea among species with globose-hemispherical, sessile fruitbodies and with receptacular hairs in fascicles. In contrast, species with shallow cupulate or applanate fruitbodies and rigid, dark-coloured marginal hairs were accommodated in subtribe Ciliares, a species group now constituting the 'core' members of *Scutellinia* and *Cheilymenia*. According to Møller (1958) *S. scutellata* was in Denmark formerly named *Peziza hirta* Schum., but, as also emphasized by Møller (1958), Schumacher's description and picture in Fl. Dan., pl. 1950, fig. 2, contradict this interpretation. A collection in Oslo labelled *Peziza hirta* no 155 leg. N. Moe 1840, having been sent to Fries and with Fries' annotation on the envelope, represents a *Geopora* species. If necessary, this material may serve as a neotype of *P. hirta* in the original sense of Schumacher and Fries. Regardless of whether the name is rejected or adopted it cannot, based on the above circumstances, be applied to a member of the genus *Scutellinia*.

hirtipes, *Scutellinia hirtipes* (Cooke) O. Kuntze, Rev. Gen. Pl. 3:520. 1898. ≡ Peziza hirtipes Cooke, Bull. Buffalo Acad. Sci. 2: 290. 1875.

= PLECTANIA MELASTOMA (Sow.) Fuck., Jb. nassau. Ver. Naturk.23/24:324. 1870.

Seaver (1928) is probably right when, based on the protologue (Cooke 1875), he placed *P. hirtipes* into synonymy with *Bulgaria melastoma* (= *P. melastoma)*.

hirtococcinea, *Scutellinia hirtococcinea* (Phill. et Plowr.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza hirtococcinea Phill. et Plowr., Grevillea 8:100. 1879. ≡ Ciliaria hirtococcinea (Phill. et Plowr.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

The protologue suggests *Scutellinia*. Boudier (1907) apparently also reached this conclusion when he referred it to his concept of *Ciliaria*. I have not been able to locate authentic specimens of this taxon. The name was not adopted by Rehm (1896) nor Seaver (1928).

hybrida, *Scutellinia hybrida* (Sow.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza hybrida Sow., Engl. Fungi t. 369, f. 1. 1803.

≡ TRICHOPHAEA HYBRIDA (Sow.) T. Schum. comb. nov. [Basionym: Peziza hybrida Sow., Engl. Fungi t. 369, fig. 1. 1803].

Specimen examined: England. sin. dat. labelled *Peziza hybrida* [- ex herb. Sowerby (K) – lectotype here selected].

The above cited authentic material represents *Trichophaea gregaria* (Rehm) Boud. as currently circumscribed. Since *Peziza hybrida* Sow. provides an older name, the necessary new combination is made. Fries (1822) did not take up this species, but placed it as a form of *Peziza hirta* Schum. Boudier (1907) referred it to *Lachnea* Fr.

hystrix, *Scutellinia hystrix* (Saut.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza hystrix Saut., Fl. allg. bot. Zeitung 24:311. 1841 [non Peziza hystrix Berk., Ann. Mag. Nat. Hist. II, 9:201. 1852].

On the basis of the diagnosis, the taxon must be excluded from *Scutellinia.* The hymenium is described as pale (livid) and the brownish black hairs as long and non-septate. Boudier (1907) referred it to *Tricharia* (= *Tricharina* Eckbl.). Yang & Korf (1985) stated that the original record of a woody substrate is wrong for *Tricharina.* There seems to be no authentic material of this species left in Berlin. Velenovsky (1934) adopted the name when recording *Lachnea hystrix* (Saut.) Rehm var. *carpathica* and *L. hystrix* var. *prunicola* from Czechoslovakia. According to Svrcek (1979) these two varieties represent *Scutellinia ampullacea* (= *S. olivascens)* and *S. cervorum* (= *S. crinita)* respectively.

imperialis, *Scutellinia imperialis* Beck ex O. Kuntze, Rev. Gen. Pl. 2:869. 1891. [= Peziza (Humaria) imperialis Beck ex Becker, Fl. Hernst. Niederöster., 2. Flora 132. 1884 – nomen illegit., later homonym of Peziza imperialis Peck, Rep. New York State Mus. 29: 54. 1875, ≡ Sowerbyella imperialis (Peck) Korf] ≡ Lachnea austriaca Beck ex Sacc. nomen novum, Syll. fung. 8: 169. 1889.

≡ SARCOSCYPHA AUSTRIACA (Beck ex Sacc.) Boud., Hist. Class. discom. d'Eur. 55. 1907.

insignis, *Scutellinia insignis* (Cr.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Ascobolus insignis Cr., Ann. Sci. Nat. ser. IV, 10:196. 1858.

≡ CHEILYMENIA INSIGNIS (Cr.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

irregularis, *Scutellinia irregularis* Clem., Bull. Torr. Bot. Club 30:90. 1903.

Specimen examined: U.S.A. Pike's Peak 7500 feet /8.1895 A.A.B, labelled *Humaria irregularis* (NEB-ex herb. Clements).

The above cited material comprises crushed fruit-bodies apparently referable to a *Discina* species, and do not fit the original description of *S. irregularis*. It had been collected 4 years prior to the material mentioned in the protologue (Jack Brook, Minnehaha) (Clements 1903). Although possibly authentic, it cannot serve as a neotype of *S. irregularis*. The description provided by Clements (1903) and Seaver (1928) suggests a fungus lacking carotenoids and having narrow, stiff hairs, probably a *Trichophaea* or *Trichophaeopsis* species. The species should be excluded from *Scutellinia* in its present circumscription.

ischnotricha, [*Scutellinia ischnotricha* Le Gal, Prodr. fl. mycol. Madag. 4:155. 1953 – nomen nudum] [≡ Scutellinia ischnotricha Le Gal ex Le Gal, Bull. Soc. mycol. Fr. 78: 213. 1962 – nomen non rite publicatum]

S. ischnotricha was provisionally described (without a Latin diagnosis) by Le Gal (1953). When intending to validate the name (Le Gal 1962), she provided a Latin description, but failed to designate a nomenclatural type. Thus, according to the present rules of ICBN (Article 37), the name is illegitimate and unavailable for taxonomic use.

japonica, *Scutellinia japonica* (Berk. et Curt.) O. Kuntze, Rev. Gen. Pl. 3:520. 1898. ≡ Peziza japonica Berk. et Curt., Proc. Am. Acad. Arts Sci. 4:127.1860. ≡ Plectania japonica (Berk. et Curt.) Sacc., Syll.fung. 8:163. 1889.

Based on the description, this taxon probably belongs in *Plectania* sensu str. It can safely be excluded from *Scutellinia*.

labellum, *Peziza labellum* Bull., Herb. Fr. t. 204. 1784. = Peziza hemisphaerica Web. in Wigg., Fl. Hols. 105. 1780. = Peziza hemisphaerica Web. in Wigg.:Fr., Syst. mycol. 2: 82. 1822.

Fries (1822) did not adopt the name, but placed it in synonymy with *P. hemisphaerica,* as did Cooke (1879) and Seaver (1928). No authentic material has been found. A collection in herb K, labelled *P. umbrorum* Fr. var. *labellum,* [France. Chaillet /4.1817 ex herb. J. Gay], is referable to *Trichophaea woolhopeia* (Cooke & Phill.) Arnauld.

laeticolor, *Scutellinia laeticolor* (Karst.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza laeticolor Karst., Mycol. Fenn. 1: 66. 1871. ≡ Ciliaria laeticolor (Karst.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ MELASTIZA LAETICOLOR (Karst.) T. Schum. comb. nov. [Basionym: Peziza laeticolor Karst., Fungi Fenniae exsicc. no. 924. 1870. (Mycol Fenn. 1:66. 1871.)]

Specimen examined: Finland. Mustiala 12. Sept. P. Karsten, Fungi Fenniae Exs. 924 (K – isotype. Norway. Akershus. Frogn. Fjellstrand. 2.10.1983 K. Bergsnov Hansen (O). Oppland. Lunner. S. Oppdalen 18.10.1981 E. Bendiksen (O). Sør-Trøndelag. Trondheim. Byneset 9.8.1982. R. Kristiansen (O).

A full description of this species was given by Spooner (1981), who recorded it from England under the new name *Melastiza asperula*. The English material and that of Karsten agree in all details. *Cheilymenia alleghenensis Denison*, which was recorded from North America (Denison 1961), may also prove to be a recent synonym. The species has occurred in Norway in three localities. The mature ascospores have a remarkable ornamentation of flattened crests, forming a fine-meshed reticulum. I agree with Spooner (1981), who found that of existing genera the species was best accommodated in the genus *Melastiza*. However, the hairs, which are superficial, brownish, and partly stiff, deviate from what has been previously accepted in this genus. Nevertheless, the spore guttulation, shape and ornamentation suggest *Melastiza,* as do the red-orange colour of the hymenium and the anatomy of the excipular tissues. Thus, rather than erecting a new genus for this species, it has been referred to *Melastiza,* in agreement with Spooner (1981).

lancifera, *Ciliaria lancifera* (Haszl.) Boud., Hist. Class. discom. d'Eur. 62. 1907. ≡ Crouania lancifera Haszl., Verh. zool.-bot. Gesellsch. Wien 37: 166. 1887 [ut 'Cruania' – lapsus calami].

On the basis of the original description, cf. *Lamprospora* de Not. or *Ramsbottomia* Buckl.

lanuginosa, *Scutellinia lanuginosa* (Bull.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza lanuginosa Bull., Champ. Fr. 261. 1788. ≡ Sepultaria lanuginosa (Bull.) Rehm, Rabenh. Krypt.-Fl. III, 1:1077. 1896.

= ?Geopora arenicola (Lév.) Kers, Sv. Bot. Tidskr. 68:345. 1974.

It is generally accepted that the species belongs in *Sepultaria* (= *Geopora)*. Species limits in this genus are far from clear. Rehm (1896) treated *S. lanuginosa* separately, whilst Seaver (1928) placed it in his broad concept of *S. arenicola*. It can safely be excluded from *Scutellinia*.

lapidaria, *Scutellinia lapidaria* (Cooke in Phill.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza lapidaria Cooke in Phill., Man. Brit. Discom. 211. 1887. ≡ Ciliaria lapidaria (Cooke in Phill.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

= TRICHARINA GILVA (Boud. in Cooke) Eckbl., Nytt Mag. Bot. 15:60. 1968.

Specimen examined: England. Bristol, between pathway stones, labelled *P. hybrida* Sow. sin. dat. (K- ex Phill. – lectotype).

This is a member of the genus *Tricharina* Eckbl. Yang and Korf (1985) referred it to *T. gilva*.

lasioboloides, *Scutellinia lasioboloides* (March.) Lamb., Fl. mycol. Belge, Suppl. 1: 299. 1887. ≡ Lachnea lasioboloides March., Bull. Soc. Roy. Bot. Belg. 24: 68. 1885.

I have not seen authentic material of this species. The description of a minute, yellow-orange, hairy species with nearly globose, smooth ascospores, growing on dung, seems to preclude assignment to *Scutellinia*. Boudier (1907), obviously by error, accommodated it simultaneously in *Lasiobolus* and *Pyronemella*.

latispora f., – [*Scutellinia scutellata* (L.) Lamb. f. *latispora* Svr. in Horak, Nova Hedwigia 2: 498. 1960 – nomen nudum]

The name was published without designating a nomenclatural type and is invalid according to the present rules of ICBN, article 37.

laxmannii, *Scutellinia laxmannii* (Weinm.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza laxmannii Weinm., Hymeno- et Gastero-mycetes hucusque in imperio rossico observatos 438. 1836.

The protologue gives no microscopic details. However, the pale ochraceous to alutaceous fruitbodies, the short pale brown marginal hairs and the occurrence on dung-enriched soils are scarcely indicative of *Scutellinia* (cf. Weinmann 1836). On the basis of the original diagnosis, cf. *Cheilymenia*. Boudier (1907) referred it to *Melastiza*. The name was adopted neither by Rehm (1896) nor Seaver (1928).

lentiformis, *Scutellinia lentiformis* (Pers. ex Sacc.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. [ut ('Pers.') Kuntze]. ≡ Lachnea lentiformis Pers. ex Sacc., Michelia 1:545. 1880.

≡ CHEILYMENIA LENTIFORMIS (Pers. ex Sacc.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

Specimen examined: France. Chaillet. Avril 1817 (K – ex herb. Gay, labelled *Peziza lentiformis* Pers. 294 - neotype here selected).

Saccardo (1889) attributes this taxon to Persoon, apparently based on information from Cooke and Phillips concerning material existent in the herbarium at Kew. The above cited specimen is the only material of this taxon located in Kew, and it is here selected as a neotype of Saccardo's species. *Peziza lentiformis* Pers. appears to be a manuscript name only. The above cited specimen represents a soil-inhabiting *Cheilymenia* species previously unknown to the author.

livida, *Scutellinia livida* (Schum.) Lamb., Fl. mycol. Belge, Suppl. 1:299.1887. ≡ Peziza livida Schum., Plant. Säll. 2: 422. 1803. ≡ Peziza livida Schum.:Fr., Syst. mycol. 2: 86. 1822.

The original description and table indicate *Trichophaea* sensu lato. Boudier (1907) refers it to *Tricharia* (= *Tricharina* Eckbl.). A collection in Kew labelled 'Christiania (NORWAY) Blytt sin. dat. – ex herb Broome, *Peziza livida* Schum.' represents *Trichophaeopsis bicuspis* (Boud.) Korf & Erb. This material fits the description of *P. livida* fairly well, and the above cited material might serve as a neotype of *Peziza livida* Schum. if necessary. Anyhow, *P. livida* must be excluded from *Scutellinia* in its present circumscription.

loennbohmii, *Lachnea loennbohmii* Karst., Fin. Vetensk. Soc. Förh. 46 (11):4. 1904.

Nomenclatural type: Switzerland. /9.1901 leg. O.A.F. Lönnbohm.

It is impossible from the short, inaccurate description of Karsten (1904) to conclude whether this is a *Scutellinia* species or not.

longiseta, *Lachnea longiseta* Penz. et Sacc., Malphigia 15: 203. 1901.

Nomenclatural type: Indonesia. Java. Tjibodas 8.3.1897 O. Penzig 961.

The original description suggests *Scutellinia*. The taxon was compared with *L. scutellata*, but distinguished by habitat (?) and colour of the hairs (?) (Penzig & Saccardo 1901). I have not been able to locate the type of this species.

lugubris, *Scutellinia lugubris* (Kalchbr.) O. Kuntze, Rev. Gen. Pl. 3: 520. 1898. ≡ Peziza lugubris Kalchbr., Mathem. és Természettud. Közlemenyek 3:239. 1865.

= URNULA CRATERIUM (Schw.) Fr., Nova Act. Soc. Sci. Ups. 3, 1:122. 1851.

The description suggests *Urnula*, and Rehm (1896) and Boudier (1907) are probably correct in referring this taxon to *U. craterium*.

luteopallens, *Peziza luteopallens* Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:18. 1869.

≡ PSEUDOMBROPHILA LUTEOPALLENS (Nyl.) T. Schum. comb. nov. [Basionym: Peziza luteopallens Nyl., Not. Sällsk. Fauna Fl. Fenn. Förh. 10: 18. 1869].

Specimen examined: Finland. Nylandia: Helsingfors, ad observatorium astronomicum 21.10.1862. (H – holotype).

The above cited specimen is conspecific with *Pseudombrophila deerrata* (Karst.) Boud., the type species of the genus *Pseudombrophila*. *P. luteopallens* is the earlier and therefore correct name for this species.

macrochaeta, *Scutellinia macrochaeta* (Fr.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza macrochaeta Fr., Nov. Act. Soc. Sci. Upsala III, 1:121. 1851.

The original description (Fries 1851) seems to preclude assignment to *Scutellinia*. The name has not been adopted in recent literature.

macrospora, *Scutellinia macrospora* (Svr.) Le Gal, Bull. Soc. mycol. Fr. 80: 123. 1964. ≡ Lachnea lusatiae (Cooke) Sacc. var macrospora Svr., Sb. Nár. muz. Praze IV B (6):58. 1949 ('1948').

≡ SCUTELLINIA MACROSPORA (Svr.) Le Gal, Bull. Soc. mycol. Fr. 80:123. 1964.

Nomeclatural type: PRM 150963 – holotype, Czechoslovakia. prope Trebon /7.1926 leg. Weinzettl.

I requested the type specimen from PRM, but they were unable to locate it. The characteristic features of this taxon, especially the ascospore characteristics, leave little doubt about its identity within *Scutellinia*, and the name has been adopted in my monograph (Schumacher 1988).

maculosa, *Scutellinia maculosa* (Phill.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza maculosa Phill., Grevillea 5: 116. 1877.

The diagnosis of brownish apothecia growing on cow dung, undulating hairs and small ascospores indicate a *Fimaria* species.

martii, *Scutellinia martii* (Strauss in Sturm) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza martii Strauss in Sturm, Pilze Deutschl., Heft. 33:19. 1853.

The description of large, whitish fruit-bodies with pale hairs excludes the possibility of a *Scutellinia* as here conceived. Rehm (1896) suggested a relationship to *Sowerbyella radiculata* (Sow.) Nannf., while Boudier (1907) accommodated this taxon in *Tricharia* (= *Tricharina* Eckbl.).

melaloma, *Scutellinia melaloma* (Alb. et Schw.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza melaloma Alb. et Schw., Consp. Fung. 336. 1805. ≡ Peziza melaloma Alb. et Schw.:Fr., Syst. mycol. 2: 68. 1822.

≡ ANTHRACOBIA MELALOMA (Alb. et Schw.) Arnauld, Bull. Soc. mycol. Fr. 9: 112. 1893.

melastoma, *Scutellinia melastoma* (Sow.) O. Kuntze, Rev. Gen. Pl. 3: 520. 1898. ≡ Peziza melastoma Sow., Engl. Fungi, t. 149. 1799. ≡ Peziza melastoma Sow.:Fr., Syst. mycol. 2:80. 1822.

≡ PLECTANIA MELASTOMA (Sow.) Fuck., Jb. nassau. Ver. Naturk. 23/24: 324. 1870.

michiganensis, *Scutellinia michiganensis* (Povah) Povah, Pap. Mich. Acad. Sci.20: 130. 1935. ≡ Patella michiganensis Povah, Mycologia 24 : 240. 1932.

= CHEILYMENIA COPRINARIA (Cooke) Boud., Hist. Class. discom. d'Eur. 63. 1907 (fide Denison 1964).

miniata, *Scutellinia miniata* (Fuck.) Lamb., Fl. mycol. Belge, Suppl. 1:300. 1887. ≡ Humaria miniata Fuck., Jb. nassau. Ver. Naturk. 29/30:32. 1875.

= MELASTIZA CHATERI (W.G. Smith) Boud., Hist. Class. discom. d'Eur. 64. 1907.

Specimen examined: Austria. ca. Hattenheim, ad terram humidam, rarissime, sin. dat., F.rhen. 2688 (S-isotype).

This is *M. chateri* as currently circumscribed, a conclusion also reached by Seaver (1928).

nigra, *Scutellinia nigra* (Bull.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. [ut (Sow.) O. Kuntze)] ≡ Peziza nigra Bull., Herb. Fr. t. 460. 1789.

= BULGARIA INQUINANS (Pers.) Fr., Syst. mycol. 2:167. 1822.

ochroleuca, *Scutellinia ochroleuca* (Bres. ex Sacc.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. [≡ Peziza ochroleuca Bres., Fungi trid. 1: 92. 1887, later homonym, non Peziza ochroleuca Bolt., Hist. Fung. 105. 1789.]

≡ Lachnea ochroleuca Bres. ex Sacc., Syll. fung. 8: 182. 1889.

≡ TRICHARINA OCHROLEUCA (Bres. ex Sacc.) Eckbl., Nytt Mag. Bot. 15:61. 1968.

oligotricha, *Scutellinia oligotricha* (Karst.) Lamb., Fl. mycol. Belg., Suppl. 1:299. 1887. ≡ Peziza oligotricha Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:127. 1869.

= CHEILYMENIA spec.

Specimen examined: Finland. Tavastia australis. Tammela. Mustiala, ad terram inter acus pini 13.8.1866 P.A. Karsten no. 2882 (H – holotype).

The holotype specimen consists of clustered, yellowish apothecia (4-7 mm) with scattered hairs to 5-600 μm long. The ascospores are eguttulate, ellipsoid, 15-17 x 8-9 μm with a loosening perispore in lactic acid. The material is referable to *Cheilymenia*.

pallida, *Scutellinia pallida* (Naum.) Cash in Trott., Saccardo's Syll. fung. (New York) 26: 506. 1972. ≡ Lachnea pallida Naum., Morbi Plant. 209. 1928.

Nomenclatural type: Russia. Leningrad. Pavlovsk, ad terram.

I have been unable to obtain the type from Leningrad. According to the protologue the ascocarps are whitish with dark, multiseptate hairs and narrowly ellipsoid, verruculose ascospores. These features may indicate a white-coloured variety or species of *Scutellinia*, or rather a member of *Trichophaea* sensu lato.

palustris, *Scutellinia palustris* (Speg. ex Sacc.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Lachnea palustris Speg. ex Sacc., Syll. fung. 8:185. 1889. = Sepultaria arenicola (Lév.) Massée, Brit. Fungus Pl. 4:390. 1895 (fide Gamundí1975).

= GEOPORA ARENICOLA (Lév.) Kers, Sv. Bot. Tidskr. 68: 345. 1974.

pellita, *Scutellinia pellita* (Cooke et Peck) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza pellita Cooke et Peck, Grevillea 1:5.1872.

≡ GEOPORA PELLITA (Cooke et Peck) T. Schum., Norw. J. Bot. 26:56. 1979.

phaeoloma, *Scutellinia phaeoloma* (Wallr.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza phaeoloma Wallr., Fl. Crypt. Germ. 2: 463. 1833.

According to the protologue, which was recited by Rehm (1896), *S. phaeoloma* is a large species (to 10 mm) with yellowish hymenium and densely set hairs along the margin. Boudier (1907) referred it to *Melastiza*, however, it might just as well represent a *Scutellinia* or *Cheilymenia* species.

phlyctispora, *Scutellinia phlyctispora* (Lepr. et Mont. in Mont.) Le Gal, Prodr. Fl. mycol. Madag. 4: 159. 1953. ≡ Peziza phlyctispora Lepr. et. Mont. in Mont., Ann. Sc. Nat., sér. 3, 4: 358. 1845.

≡ ALEURIA PHLYCTISPORA (Lepr. et Mont. in Mont.) T. Schumacher comb. nov. [Basionym: Peziza phlyctispora Lepr. et Mont. in Mont., Ann. Sc. Nat., sér 3, 4:358. 1845.]

Specimen examined: French Guiana. Cayenne, in herbosis sabulosis /1.1845 leg. Leprieur (PC-holotype).

The above cited type specimen represents a taxon previously unknown to the author. Le Gal (1953) adopted Montagne's taxon when recording some *Scutellinia* specimens from Madagascar, specimens which have been referred to *S. badioberbis* in my monograph (Schumacher 1988). Montagne's specimen, however, is not a *Scutellinia;* the type specimen consists of yellowish-orange apothecial remains, the apothecial margin being hairless, while some hyaline, flexuous hyphae extend from the outermost excipular cells of the receptacle. The excipular tissues are densely collapsed and difficult to interpret. However, the ascospores are significant, being ellipsoid in shape with large cyanophilous tubercles on the spore wall and the tubercles containing several internal guttules, simulating a 'reticulate' infrastructure of the tubercles. Similar material has been described quite recently from the Galapagos Islands as *Jafneadelphus tectipus* Spooner (Reid, Pegler & Spooner 1981). This name has recently been recombined in *Aleuria* (Zhuang & Korf 1986). I have not seen material of *J. tectipus*, but the provided description fits Montagne's specimen in all important details. There are features in the present material of *P. phlyctispora* that makes one think of *Aleuria*, and following the intention of Zhuang & Korf the taxon is recombined in that genus. Saccardo (1889) referred *P. phlyctispora* to his broad concept of *Neottiella*.

phymatodea, *Scutellinia phymatodea* S.C. Kaushal & R. Kaushal in Kaushal, Kaushal & Rawla, Bibl. Myc. 91:594. 1983.

Nomenclatural type: India. Himachal Pradesh. Mandi. Revalsar, on damp soil 11.10.1971 S. Chander 2430 (PAN).

I requested the type from PAN, but received no answer to my enquiry. The description suggests a species unknown to me and probably not a member of the genus *Scutellinia*.

piliseta, *Lachnea piliseta* (Clem.) Sacc. et Syd. in Sacc., Syll. fung. 16:1147. 1902. ≡ Pelodiscus pilisetus Clem., Rep. Bot. Surv. Nebr. 5:8. 1901.

The type specimen has not been located in NEB or NYS. The original diagnosis suggests *Cheilymenia* or *Scutellinia*.

pilosa, *Scutellinia pilosa* (Schum.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza pilosa Schum., Enum. Pl. Saell. 2:433. 1803. ≡ Peziza pilosa Schum.:Fr., Syst. mycol. 2: 87. 1822. ≡ Ciliaria pilosa (Schum.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

The name is apparently lost. Fries' description (1822) of a reddish ascocarp with long, rigid, brown apothecial hairs and a xylophilous habit, suggests *Scutellinia*. The fact that the species was accommodated in subtribe *Ciliares* of *Peziza* tribe *Sarcoscypha* with species having been referred to *Scutellinia* by concecutive authors, strengthens this suggestion. It may well represent *S. scutellata*.

plumieri, *Scutellinia plumieri* (Fr.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza plumieri Fr., Syst. mycol. 2: 84. 1822.

The species was described based on specimens collected in Central America (Fries 1822). The large, bright red ascocarps with hairs in fascicles on the receptacular surface, suggest *Cookeina* or *Phillipsia*. The name does not seem to have been adopted in recent literature.

polytrichi, *Scutellinia polytrichi* (Schum.) Maire, Publ. Junta Ciencies Nat. de Barcelona, ser. Bot. 15 (2):19. 1933. ≡ Peziza polytrichi Schum., Enum. Pl. Saell. 2:423. 1803. = Peziza polytrichi (Schum.:Fr.), Syst. mycol. 2:70. 1822.

From the diagnosis this is a small species having orange-coloured apothecia with hairs borne in fascicles and growing in tufts of *Polytrichum*. Maire (1933) regarded it as conspecific with *Peziza albocincta* Berk. & Curt., a taxon now accommodated in *Neottiella*, whilst Le Gal (1940) argued for its relationship within *Lamprospora*. It can safely be excluded from the current concept of *Scutellinia*.

populnea var., – *Lachnea hirta* (Schum.) Gill. var. *populnea* Vel., Mon. Discom. Boh.1: 303. 1934.

The holotype in PRM has not been available for examination. According to Svrcek (1971, 1979) this is a taxonomic synonym of *S. cervorum* (= *S. crinita*).

praecox, *Scutellinia praecox* (Karst.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza praecox Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 10:124. 1869.

≡ TRICHARINA PRAECOX (Karst.) Dennis, Kew Bull. 25:338. 1971.

pratensis, *Scutellinia pratensis* (Vel.) Le Gal, Bull. Soc. mycol. Fr. 87: 438. 1972 ('1971'). ≡ Lachnea umbrorum (Fr.) Gill. var. pratensis Vel., Mon. Discom. Boh. 1: 412. 1934.

Nomenclatural type: PRM 147282 -lectotype selected by Svrcek (1971).

Type or authentic material has not been available from Prague. Svrcek (1971, 1979) refers this taxon to *S. umbrorum*.

pulcherrima, *Scutellinia pulcherrima* (Cr.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Ascobolus pulcherrimus Cr., Ann. Sci. Nat. IV, 10: 196. 1858.

≡ CHEILYMENIA PULCHERRIMA (Cr.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

regalis, *Scutellinia regalis* (Vel.) Svr., Sb. Nár. muz. Praze 32B (2-4):154. 1979 ('1976'). ≡ Lachnea regalis Vel., Mon. Discom. Boh. 1:306. 1934.

Nomenclatural type: PRM 151387 - holotype.

The type specimen has not been available from Prague. Velenovsky's description suggests a taxon in the species complex around *S. crinita/scutellata*.

rhizomorphae, *Scutellinia rhizomorphae* (Ell. et Everh.) O. Kuntze, Rev. Gen. Pl. 3: 520. 1898. ≡ Peziza rhizomorphae Ell. et Everh., J. Mycol. 4: 98. 1888.

= PLECTANIA MELASTOMA (Sow.:Fr.) Fuckel, Jb. nassau. Ver. Naturk. 23/24:324. 1870 (fide Seaver 1928).

rubicunda, *Scutellinia rubicunda* (Quél.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Ciliaria rubicunda Quél., C.R. Assoc. Fr. Av. Sc. 14:451. 1886 ('1885').

I have not been able to locate authentic collections of this species. Quélet (1886a) referred it to subgenus *Ciliaria* of *Humaria* together with undoubted *Scutellinia* species such as *Peziza crinita*, *P. hirta*, *P. ciliata* (= *S. scutellata*) and *P. umbrata*. The diagnosis suggests a *Scutellinia* species with 'reticulo-alveolate' ascospores (= *S. pseudotrechispora* ?). Boudier (1907) refers it to *Melastiza*.

rubra, *Scutellinia rubra* (Cooke ex Phill.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. [≡ Peziza rubra Cooke, Mycographia 1:83. 1876 – nomen illegit., later homonym of Peziza rubra Peck, Ann. Rep. N.Y. State Mus. 24:95. 1872.] ≡ Lachnea rubra Cooke ex Phill., Man. Brit. Discom. 225. 1887.

≡ CHEILYMENIA RUBRA (Cooke ex Phill.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

Specimen examined. England. Batheaston, April 1872 leg. C.E. Broome, labelled *C. theleboloides*, red form (K- ex Cooke-holotype).

This is a *Cheilymenia* species, as are Ed. 1, no 572 and Ed. 2, no 186 of Fungi Brittanici Exsiccati, labelled *Peziza (Sarcoscypha) rubra* (K), which I have also examined.

rufobrunnea, *Lachnea rufobrunnea* P. Henn. in Voeltzkow, Reise in Ostafrika 1903-1905, Wissensch. Ergebnisse 3: 32. 1908.

Nomenclatural type: Madagaskar. Fénérive, Herdenweise auf Erdboden.

I have been unable to locate type or authentic collections of this species. The description and figures (Hennings 1908) suggest *Scutellinia*.

scheremetjeffii, *Lachnea scheremetjeffii* P. Henn., Hedwigia 42 (Beibl.):117. 1903.

Nomemclatural type: U.S.S.R. Kreis Podolsk. Michailowskoje 16.7.1902 G. Scheremetjeff no. 143.

I have not located type or authentic specimens of this taxon. The description and habitat suggest *Scutellinia*. In the protologue it is compared with *L. livida* and *L. olivascens* based on the faded colour of the dried fruit bodies (cf. Hennings 1903).

schistarenaria, *Scutellinia schistarenaria* (Saut.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza schistarenaria Saut., Hedwigia 16: 73. 1877.

The description of a greyish white, discoid ascocarp with short, brown hairs suggests *Trichophaea* sensu lato. Boudier (1907) refers it to *Tricharia* (= *Tricharina* Eckbl.) The type specimen was not found by Winter (1881) nor Keissler (1917) and seems to be lost.

schizospora, *Ciliaria schizospora* (Phill.) Boud., Hist. Class. discom. d'Eur. 62. 1907. ≡ Peziza schizospora Phill., Grevillea 3: 31. 1874.

≡ SPHAEROSPORELLA BRUNNEA (Alb. & Schw.:Fr.) Svr. & Kub., Ceská Myk. 15:65. 1961.

Specimen examined: England. Shrewsbury, on charcoal bed /9.1872 (K- ex Phill.- holotype).

This is *S. brunnea* in its present circumscription. Rifai (1968) deferred from a transfer to *Sphaerosporella* as he could find no excipular hairs in the specimen he examined. The above cited specimen, which rightly should be regarded as the holotype of *P. schizospora* Phill., has short hairs typical of *S. brunnea.*

scubalonta, *Scutellinia scubalonta* (Cooke et Ger. in Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza scubalonta Cooke et Ger. in Cooke, Grevillea 4: 92. 1875.= Cheilymenia stercorea (Pers.) Boud., Hist. Class. discom. d'Eur. 63. 1907 (fide Denison 1964)

= CHEILYMENIA CILIATA (Bull.) Maas G., Proc. Kon. Ned. Akad. Wetens.-Amsterdam, ser. C, 72: 313. 1969.

scutelloides, *Peziza scutelloides* Ell., Bull. Torr. Bot. Club 9: 18. 1882.

= SPHAEROSPORELLA HINNULEA (Berk. et Br.) Rifai, Verh. Kon. Nederl. Akad. Wetensch., Afd. Natuurk., Tweede Reeks, 57 (3): 100.1968.

semiobscura, *Scutellinia semiobscura* Le Gal, Bull. Soc. mycol. Fr. 87: 435. 1972 ('1971').

Nomenclatural type: Congo. Sibiti /3. 1948 R. Heim (PC - ex Le Gal – holotype).

I requested the type from PC, but they were unable to locate it. Material in Kew referred to this species by Le Gal are conspecific with either *Scutellinia balansae* or *S. jungneri.*

SEE ERRATA

sepulta, *Scutellinia sepulta* (Fr.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza sepulta Fr., Nov. symb. myc. 26. 1851. ≡ Geopora sepulta (Fr.) Korf et Burdsall in Burdsall, Mycologia 60:500. 1968.

= GEOPORA ARENICOLA (Lév.) Kers, Sv. Bot. Tidskr. 68: 345. 1974.

sequoia, *Scutellinia sequoia* (Phill.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza sequoia Phill., Grevillea 7: 22. 1878.

≡ WILCOXINA SEQUOIA (Phill.) T. Schum. comb. nov. [Basionym: Peziza sequoia Phill., Grevillea 7: 22. 1878].

Specimen examined: U.S.A. California, sin. dat. Harkness no 638, on bark and foliage of *Sequoia gigantea* (K- syntype, here selected as lectotype of *P. sequoia*).

This is *Wilcoxina alaskana* Kempton, Yang & Korf such as circumscribed by Yang & Korf (1985). Since it provides an older name, the new combination in *Wilcoxina* is proposed. Yang & Korf (1985) apparently studied the same specimen, but referred it to *Cheilymenia*.

staritzii, *Ciliaria staritzii* (P. Henn.) Boud., Hist. Class. discom. d'Eur. 62. 1907. ≡ Sphaerospora staritzii P. Henn., Hedwigia 42 (Beibl.) 1:19. 1903.

On the basis of the diagnosis, cf. *Lamprospora* de Not. or *Ramsbottomia* Buckl.

stenostoma, *Scutellinia stenostoma* (Mart.) O. Kuntze, Rev. Gen. Pl. 3: 520. 1898. ≡ Peziza stenostoma Mart., Fl. Crypt. Erlang. 469. 1817. ≡ Peziza stenostoma Mart.:Fr., Syst. mycol. 2:80. 1822.

≡ Sarcoscypha stenostoma (Mart.) Rehm in Rabenh., Krypt.-Fl. Deutschl. II, 1(3):1074. 1896.

The original description suggests *Sarcoscypha,* and Rehm (1896) is probably right when referring it to that genus.

stercorea, *Scutellinia stercorea* (Web. in Wigg.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Patella stercorea Web. in Wigg., Prim. Fl. hols. 106. 1780. ≡ Cheilymenia stercorea (Web. in Wigg.) Boud., Hist. Class. discom. d'Eur. 63. 1907.

= CHEILYMENIA CILIATA (Bull.) Maas G., Proc. Kon. Ned. Akad. Wetens.-Amsterdam, ser. C, 72:313. 1969 (fide Maas Geesteranus 1969).

strasseri, *Sphaerospora strasseri* Bres. in Strasser, Verh. zool.-bot. Ges. in Wien 51: 422. 1901. ≡ Ciliaria strasseri (Bres. in Strasser) Boud., Hist. Class. discom. d'Eur. 62. 1907. (ut 'Stasseri' - lapsus calami).

Nomenclatural type: Austria. Sonntagberg 13.12.1900 leg. P. Strasser.

In the protologue the taxon was compared to *S. trechispora*, which it resembles in micro-anatomical details. However, the greyish-white hymenium of fresh fruit-bodies seems to preclude assignment to that species. On the basis of the diagnosis, cf. *Scabropezia* Dissing & Pfister.

sublivida, *Scutellinia sublivida* (Sacc. et Speg.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Humaria sublivida Sacc. et Speg., Michelia 1: 443. 1879.

≡ TRICHOPHAEA SUBLIVIDA (Sacc. et Speg.) Boud., Hist. Class. discom. d'Eur. 60. 1907.

subreticulata, *Scutellinia subreticulata* (Thind, Cash et Singh) Thind, J. Indian Bot. Soc. 52(3-4): 11. 1974. ≡ Humaria subreticulata Thind, Cash et Singh, Mycologia 51: 459. 1959.

Nomenclatural type: India. Uttar Pradesh. Mussoorie. Municipal Gardens, on soil 10.8.1956 Sethi 305 (PAN).

I requested the type from PAN, but got no answers to my repeated inquiries. The description suggests a species of section *Reticulatae* of *Scutellinia*.

sumneriana, *Scutellinia sumneriana* (Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza sumneriana Cooke, Mycographia 1: 63.1876 [ut 'Peziza lanuginosa Bull. var. sumneri Berk. et Br.' fide Cooke 1879:246].

≡ GEOPORA SUMNERIANA (Cooke) de la Torre, Anal. Inst. A.J. Cavanilles 32:96. 1976.

superba, *Scutellinia superba* (Vel.) Le Gal, Bull. Soc. mycol. Fr. 80: 123. 1964. ≡ Lachnea superba Vel., Mon. Discom. Boh. 1: 305, 1934.

≡ SCUTELLINIA SUPERBA (Vel.) Le Gal, Bull. Soc. mycol. Fr. 80:123. 1964.

Nomenclatural type: PRM 150964 – lectotype selected by Svrcek (1971).

The type specimen from Prague has been unavailable for an examination. According to Svrcek (1971), *S. insignispora* Svr. et J.Mor. is a taxonomic synonym, and following Svrcek (1971), the name *S. superba* has been adopted for this concept.

tenuis, *Scutellinia tenuis* (Fuck.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Humaria tenuis Fuck., Jb. nassau. Ver. Naturk. 23/24: 322. 1870.

≡ GEOPORA TENUIS (Fuck.) T. Schum., Norw. J. Bot. 26:56. 1979.

theleboloides, *Scutellinia theleboloides* (Alb. et Schw.) Lamb., Fl. mycol. Belge, Suppl. 1:300. 1887. ≡ Peziza theleboloides Alb. et Schw., Consp. fung. 321. 1805. ≡ Peziza theleboloides Alb. et Schw.:Fr., Syst. mycol. 2: 88. 1822.

≡ CHEILYMENIA THELEBOLOIDES (Alb. et Schw.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

trechisperma, *Scutellinia trechisperma* Donad., Docums. mycol. 13 (49):25. 1983 [– a superfluous name –]

≡ SCUTELLINIA TRECHISPORA (Berk. et Br.) Lamb., Fl. mycol. Belge, Suppl. 1: 299. 1887.

This is a superfluous name, erected on the basis of a specimen in herb. Berkeley in K, which represents syntype material of *S. trechispora*.

uliginosa, *Scutellinia uliginosa* Batra, Mycologia 52: 526. 1960.

= MELASTIZA spec.

Specimen examined: India. Uttar Pradesh. Rajpura (CUP - IN 132 – holotype).

This is a *Melastiza* species close, if not identical, to *M. flavorubens* (Rehm) Pfister & Korf.

umbrata, *Scutellinia umbrata* (Fr.) Lamb., Fl. mycol. Belge, Suppl. 1:299. 1887. ≡ Peziza umbrata Fr., Summa Veget. Scand. 351. 1849. ≡ Ciliaria umbrata (Fr.) Boud., Icon. Mycol. 2:pl. 372. 1906.

The original description suggests *Scutellinia,* but there is no authentic material of Fries' left. Cooke (1879) reserved the name for a segregate of *Peziza umbrorum* sensu Fries (1823), referring to Rabenhorst's Fungi europaei exsiccatum no

217 (sub nomen *Peziza umbrosa* (Mich.) Fr.) as typical. Rehm (1878) adopted the name *Humaria umbrata* (Fr.) f. *pallida* – a nomen nudum – when issuing his Ascomyceten exsiccatum no 456, simultaneously pointing out its identity with Rabenhorst's exciccatum no 217 (Rehm 1881). A reexamination of these collections [F. europ. no 217, ad Gandavum (Flandria), leg. Eugene Coemans, and Rehm's Ascomyceten no 456, Augsburg auf Kalkboden zwischen Asche in einem Hausgarten 5/1878 Britzelmayr] has shown them to be conspecific and referable to *Tricharina gilva*. Saccardo & Cooke (1881), Boudier (1907, 1910) and later Le Gal (1945), who followed Boudier, adopted the Friesian name for a *Scutellinia* (i.e. as *Ciliaria*) with small apothecia, short hairs and small ascospores. Svrcek and Kubicka (1963) used the name *S. umbrata* when recording a minute *Scutellinia* species from Czechoslovakia, material which Svrcek later accommodated under *Scutellinia minutella* (Svrcek 1981). Rehm (1899) described *Lachnea umbrata* forma *antarctica* from Patagonia with apothecia exceeding 10 mm in diam. and with hairs 100 x 15 μm. There is no material of Rehm's left in S. However, his hand-written original description and drawings, based on the type [in paludosis prope Punta-Arenas, 22.2.1895 Dusén no 2.], indicate a taxon with smooth, ellipsoid spores (20 x 10 μm), a red disc, and blackish, straight to curved, septate, marginal hairs. Gamundí (1956) combined it in *Scutellinia,* simultaneously recording some new collections from Argentina. *S. umbrata* f. *antarctica* was later incorporated in *Scutellinia marginata* (Gamundí1975). Based on the disparate use of this epithet of Fries' it is best regarded as a nomen ambiguum. Alternatively, a neotype specimen based on material from the above cited exsiccatae of Rabenhorst's or Rehm's might seem justified, then automatically excluding the taxon from *Scutellinia*.

umbrosa, [*Peziza umbrosa* Mich.:Fr., Syst. mycol. 2: 85.1822 – nomen illegit., later homonym of P. umbrosa Schrad.:Fr., Syst. mycol. 2: 66. 1822]

vinosobrunnea, *Scutellinia vinosobrunnea* (Berk. et Br.) O. Kuntze, Rev. Gen. Pl. 2:869. 1891. ≡ Peziza vinosobrunnea Berk. et Br., Trans. Linn. Soc. London II, 1:404. 1879.

Rifai (1968) studied the scanty and poorly preserved type material and found the species to be intermediate between *Nothojafnea* and *Tricharia* (= *Tricharina*). I have not seen the type specimen. However, based on the information available, it can safely be excluded from *Scutellinia.*

violacea, *Parascutellinia violacea* (Velen.) Svr., Ceská Myk. 29:129. 1975. ≡ Lachnea violacea Velen., Mon. Discom. Boh. 1:309. 1934.

= PARASCUTELLINIA ARCTESPORA (Cooke et Phill.) T. Schum. Mycotaxon 33:153. 1988.

Specimens examined: Czechoslovakia. (PRM 151383 - holotype). Bohemia centralis: Podmrac prope Cercany, 6.9.1959 leg. M. Svrcek (PRM 617791).

The examined specimens are conspecific with *Peziza arctespora*, the correct name for the generic type of *Parascutellinia*.

vitellina, *Scutellinia vitellina* (Pers.) Lamb. Fl. mycol. Belge, Suppl. 1: 300. 1887. ≡ Peziza vitellina Pers., Myc. Europ. 257. 1822. ≡ Peziza vitellina Pers.: Fr., Syst. mycol. 2: 84. 1822. ≡ Ciliaria vitellina (Pers.) Boud., Hist. Class. discom. d'Eur. 62. 1907.

≡ CHEILYMENIA VITELLINA (Pers.) Dennis, Brit. Cup fungi 27. 1960.

The identity of *P. vitellina* Pers. is not clear. Lundell & Nannfeldt (1946) and Dennis (1960) regarded it as a member of *Cheilymenia,* the latter author also making a formal transfer to that genus. Nineteenth-century authors such as Quélet (1886c), Cooke (1879) and Rehm (1896) adopted the name in the sense of *P. vitellina* Pers. ssp. *sabulosa* Moug. ex Pers., apparently accepting material from Mougeot's herbarium as typical of *P. vitellina*. This latter taxon, based on an examination of the type in K, represents *S. umbrorum*. If this material is to be regarded as representative of the 'parent' species, *P. vitellina* is the older and correct name for *S. umbrorum* (Fr.) Lamb. Fries (1822), when sanctioning the name *P. vitellina* Pers., also referred to ssp. *sabulosa,* which he interpreted as close to *P. umbrorum*. Since the original description of *P. vitellina* deviates considerably from that of *P. vitellina* ssp. *sabulosa,* the material of Mougeot is here regarded as an unacceptable type specimen of *P. vitellina*.

werthiana, *Lachnea werthiana* P. Henn. in Drygalski, Deut. Südp. Exped. 8, Bot., 1: 7. 1906.

Nomenclatural type: Antarctica. Kerguelen Island. Kerguelen st., coll. Dr. E. Werth 11.2 and 28.5.1902 and 30.1.1903.

I have been unable to locate authentic specimens of this taxon. The description of a prominent ascospore wall sculpturing suggests *Scutellinia*.

wimpfeniana, *Scutellinia wimpfeniana* (Bizz.) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Lachnea wimpfeniana Bizz., Atti Ist. Veneto Sci. Lett. Arti, ser. 6, 3:303. 1885.

The protologue is not indicative of a *Scutellinia* species. Saccardo (1889) referred it to *Lachnea* subgenus *Sepultaria,* whilst Boudier (1907) put it in *Tricharia* (= *Tricharina* Eckbl.). Yang & Korf (1985) suggests this could be a species of *Cheilymenia*. It seems safe to exclude it from *Scutellinia*.

woolhopeia, *Scutellinia woolhopeia* (Cooke et Phill. in Cooke) O. Kuntze, Rev. Gen. Pl. 2: 869. 1891. ≡ Peziza woolhopeia Cooke et Phill. in Cooke, Grevillea 6:75. 1877.

≡ TRICHOPHAEA WOOLHOPEIA (Cooke et Phill. in Cooke) Arnauld, Bull. Soc. mycol. Fr. 9: 112, 1893.

According to Seaver (1928), this is a taxonomic synonym of *T. albospadicea* (Grev.) Boud.

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TWO NEW SPECIES OF AGARICALES FROM BRAZIL

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SUMMARY

Two new species of Agaricales are described from Brazil, _Hygrocybe viridis_ sp.nov. and _Marasmius jaruensis_ sp. nov., collected in the State of Rondonia,in the Amazon region.

In 1986 a scientific expedition in the state of Rondonia, near the Jaru and Ji-Paraná rivers (10°20' S and 62°10' W), in the Amazon region of Brazil, provided an opportunity of collecting fungi. Some are known, and belong to families in the Agaricales and Aphyllophorales (CAPELARI & MAZIERO, in press). Two species, _Hygrocybe viridis_ and _Marasmius jaruensis_, are new to science and are here described with comments.

Marasmius jaruensis Capelari & Maziero, sp. nov., fig. 1

Pileus 1.5-4.0 cm latus, plano-convexus vel depressus, umbilicatus, violaceus. Lamellae sinuatae vel subdecurrentes, eburneae, subdistantes. Stipes 1.0-3.0 x 0.15 -0.30 cm, cylindricus vel compressus, caeruleus vel violaceus. Hyphae omnes fibulatae. Sporae 2.6-4.0 x 3.9-5.0 µm, subglobosae, hyalinae, tenuitunicatae. Basidia 16.8-18.0 x 2.4-4.2 µm, clavata, 2 vel 4-sporigera. Acies lamellarum fertilis. Pleurocystidia 20.0-24.0 x 3.6-4.2 µm rara, apicibus capitata. Trama hymenophoralis regularis. Cuticula pilei cellularis, ventricosis.

Holotypus: Jaru, Rondonia, 03 Oct.1986, M. Capelari & R. Maziero 660 (SP211335).

Pileus 1.5-4.0 cm diam., plano-convex to depressed, umbilicate; surface violaceous near MP 45L12 (Vatican) becoming darker towards the margin, velutinous; margin undulate. Lamellae sinuate to subdecurrent, cream-coloured, subdistant, with lamellulae. Stipe 1.0-3.0 x 0.15-0.30 cm, cylindrical to flattened; surface bluish to violaceous, fibrillose, with a white basal mycelium. Context thin, inamyloid, of inflated thin-walled hyphae, 2.0-5.0 µm diam., with clamp-connexions. Spores 2.6-4.0 x 3.9-5.0 µm, subglobosae or nearly so, hyaline, thin-walled. Basidia 16.8-18.0 x 2.4-4.2 µm, clavate, bearing two or four sterigmata. Lamella edge fertile; cheilocystidia absent. Pleurocystidia rare, 20.0-24.0 x 3.6-4.2 µm, lecythiform, with an apical capitellum, 3.5-5.0 µm diam., hyaline, thin-walled. Hymenophoral trama regular, hyaline, hyphae 2.0-4.0 µm diam., with clamp-connexions. Pileipellis an epithelium of inflated-ventricose fusoid elements, sometimes pyriform, 14.0-31.0 x 6.0-12.0 µm, with a thickened wall, hyaline.

Marasmius jaruensis belongs to section Alliacei Kühner on account of the inamyloid hyphae of the context and the smooth elements of the epithelium.

Among the species of section Alliacei cited by SINGER (1976) and PEGLER (1983), M. jaruensis differs markedly by the size of the spores and the colour of the pileus.

It is related to M. ionides Pat., which also has a violaceous pileus, however, in M. jaruensis the pileal surface does not become brown towards the margin. Other differences include the size of spores, which in M. ionides are 5.7-7.0 x 3.2-4.0,µm; the elements of the pileipellis, and the lack of caulocystidia and pileocystidia. Marasmius jaruensis grows on rotten wood.

Hygrocybe viridis Capelari & Maziero, sp. nov., fig. 2

Pileus 1.5-3.5 cm latus, convexus vel applanatus, depressus, perforatus, hygrophanus, glaber, viridis. Lamellae adnatae vel subdecurrentes, distantes, virides. Stipes 3.5-7.0 x 0.5-0.8 cm, compressus, apice viridis, basim albus, cavus, glaber, hygrophanus. Caro alba. Sporae dimorphae. Sporae magnae 8.4-11.0 x 4.8-6.0 µm ellipsoideae, hyalinae; sporae parvae 6.0-7.2 x 4.8-6.0 µm, ellipsoideae, hyalinae. Basidia dimorpha: basidia magna 45.6-50.4 x 8.4-9.6 µm, 4-sporigera; basidia parva 28.8-33.6 x 8.4-9.6

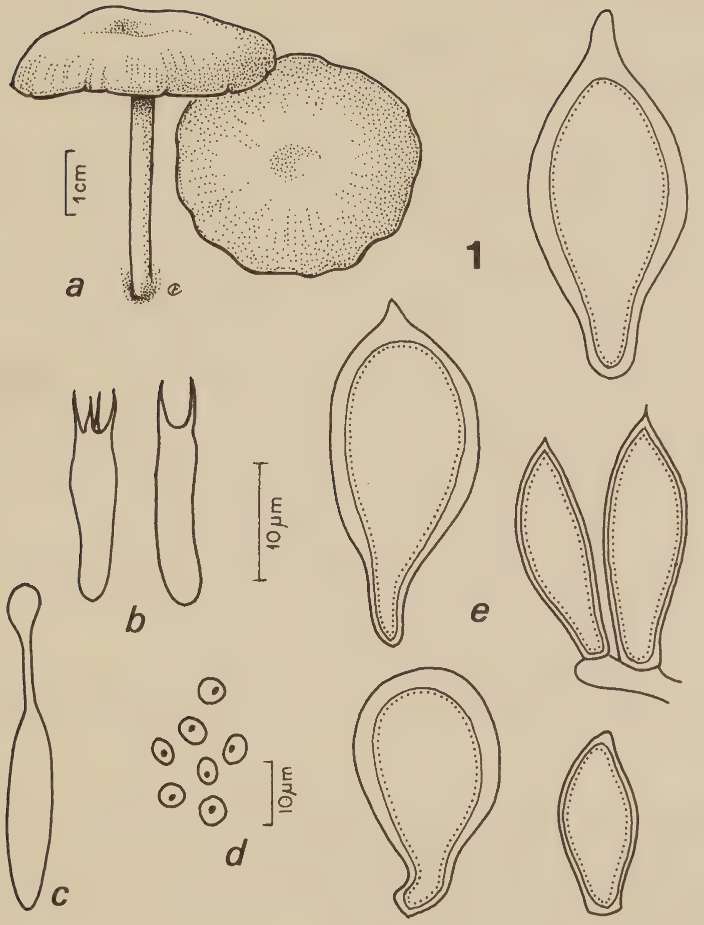
1
a
1cm
b
10µm
c
d
10µm
e

Fig.1. Marasmius jaruensis. a. habit. 2. basidia. c. pleurocystidium. d. spores. e.epicuticular elements.From the type collection.

µm, 4-sporigera. Acies lamellarum fertiles, cheilocystidia nulla. Trama hymenophoralis regularis, hyalina. Hyphae cuticulae pilei filamentosae, 8.4-12.0 µm latae, hyalinae. Fibulae frequentes.

Holotypus: Jaru, Rondonia, 08 Oct.1986, M. Capelari & R. Maziero 826 (SP211571).

Pileus 1.5-3.5 cm diam., convex then expanding, and depressed or umbilicate, perforate at the disk; surface green near MP 23H12 (chrome green), smooth, hygrophanous. Lamellae adnate to decurrent, same colour as the pileus, distant, with lamellulae. Stipe 3.5-7.0 x 0.5-0.8 cm, cylindric to flattened, green at the apex, whitish towards the base, hollow, hygrophanous, smooth and glabrous. Context thin, whitish, with interwoven, thin-walled hyphae, 7.2 - 12.0 µm diam., with clamp-connexions. Spores dimorphous. Macrospores 8.4-11.0 x 4.8-6.0 µm, elongate ellipsoid, hyaline, thin-walled. Microspores 6.0-7.2 x 4.8-6.0 µm, ellipsoid, hyaline, thin-walled. Basidia inconspicuously dimorphous. Large basidia 45.6-50.4 x 8.4-9.6 µm, clavate, normally with four sterigmata. Small basidia 28.8-33.6 x 8.4-9.6 µm, clavate, with four sterigmata. Lamella edge fertile. Cheilocystidia absent. Pleurocystidia absent. Hymenophoral trama regular, hyaline, hyphae inflated 3.6-16.8 µm diam., with clamp-connexions. Pileal surface poorly differentiated, with hyphae 8.4-12.0 µm diam.

Hygrocybe viridis is closely related to H. chloochlora Pegler & Fiard and, like it, belongs to Section Firmae Heinem. by virtue of the dimorphous basidia and spores.

These two species differ in the colour of the basidiocarp, which in H. chloochlora is yellow-green and in H. viridis is green without traces of yellow; cheilocystidia are lacking in H. viridis, but present in H. chloochlora; while the spores are shorter in the new species than in H. chloochlora.

Hygrocybe viridis was collected on the ground, among litter on the left side of the Ji-Paraná river.

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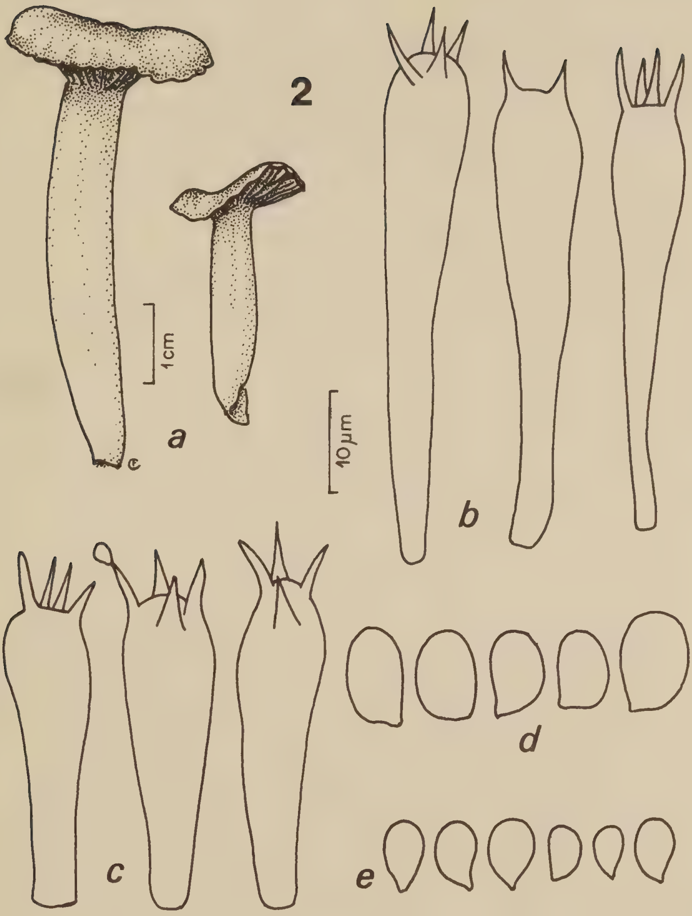
2
1cm
a
10µm
b
c
d
e

Fig.2. Hygrocybe viridis. a. habit, b. large basidia. c. small basidia. d. macrospores. e. microspores. From the type collection.

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GALACTOMYCES CITRI-AURANTII A NEWLY FOUND TELEOMORPH OF GEOTRICHUM CITRI-AURANTII THE CAUSE OF SOUR ROT OF CITRUS FRUIT

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ABSTRACT

Galactomyces citri-aurantii Butler (Hemiascomycetes, Endomycetales, Dipodascaceae), the teleomorph of the fungus that causes sour rot of *Citrus* spp. [anamorph:*Geotrichum citri-aurantii* (Ferraris) Butler] is described for the first time. It is heterothallic; the two mating types were obtained from *Citrus* soils worldwide. *Galactomyces citri-aurantii* is similar to *G. geotrichum* (Butler and Petersen) Redhead & Malloch in morphology of the anamorph but differs in several other characteristics: morphology of ascospore, colony morphology, growth rate and sexuality. *G. citri-aurantii* is similar to *G. reessii* (van der Walt) Redhead & Malloch in morphology of ascospore but differs in morphology of the anamorph, sexuality, ecology, and several physiological characteristics. Only *G. citri-aurantii* causes sour rot of citrus.

INTRODUCTION

Sour rot is an economically important disease affecting lemon [*Citrus limon* (L.) Burm. f.], orange

[*Citrus sinensis* (L.) Osbeck], grapefruit [*Citrus paradisi* Macfadyen], and other citrus species, mostly in commercial transit and storage. In the orchard it may affect fruit in contact with the soil, though sometimes rot may develop on the tree (Horn *et al*. 1958).

The cause of sour rot was first described as an asexual fungus in 1899 in Italy by Ferraris (Ferraris 1899) who named it *Oidium citri-aurantii*. Shortly thereafter, Saccardo and Sydow (1902) made the combination *Oospora citri-aurantii*. These names, especially the latter, were employed by plant pathologists working with sour rot for the next five decades. Ciferri (1955) recognized the pathogen as *Geotrichum candidum* Link and gave it the varietal name *citri-aurantii* R. Cif. & F. Cif. because of its capacity to cause rot in citrus fruit and to grow well in pasteurized lemon juice at pH 2.7. Noncitrus isolates did not cause rot in lemon and failed to grow or made only a trace of growth at pH 2.7.

In 1965 Butler *et al*., in a comparative study of a world-wide collection of 78 sour rot isolates and 100 other isolates of *Geotrichum candidum* from various sources concluded that as a group the citrus isolates were unique in physiology, but on a strictly morphological basis belonged to *Geotrichum candidum*. Two years after this work the first author spent several months in Puerto Rico; this visit provided him the opportunity to continue studies on *Geotrichum candidum*. Puerto Rico, a moist subtropical island (Pico 1950), seemed to have ideal conditions for *G. candidum*. Diverse species of wild and cultivated plants were common and *Citrus* spp. were extensively grown prior to World War II (Reuther *et al*. 1973). Soils were collected at 55 different sites chosen to include a wide range of types, rainfall regions (Pico 1950), and vegetation. Citrus species were not growing at the collection sites and the crop history of each collection site was unknown. Thirty-five soils yielded *Geotrichum candidum* but not the citrus sour rot pathogen. These findings were consistent with previous studies (Butler *et al*. 1965) which showed that it was present only in the citrus environment. Two of the cultures produced ascospores, events that later led to revival of our collection of isolates from citrus (Butler *et al*. 1965), then in storage, and to their being paired in various combinations with the idea that they might yield a sexual state. The results of this effort were positive and herein the teleomorph of the fungus responsible for the sour rot disease of citrus is described.

Because the ascospores are very similar to those of *Galactomyces reessii* (van der Walt) Redhead & Malloch, selected comparisons were made with that species and with *Galactomyces geotrichum* (Butler & Petersen) Redhead & Malloch, which has an anamorph morphologically similar to that of *G. citri-aurantii*.

MATERIALS AND METHODS

The description of *Galactomyces citri-aurantii* in this paper is based on growth in darkness at 25C on potato dextrose agar (PDA), pH 5.8, prepared, per liter from 200 g of potato and 10 g of glucose. Colonies in figure 3G, H, and I were grown on potato-tomato agar (PTA) prepared as for PDA with the addition of 200 g of tomato fruit. Colonies of *G. citri-aurantii* on this medium were very similar to those on PDA. Other agar media used to culture *G. geotrichum* and *G. citri-aurantii* were carrot root, tomato juice, orange juice, and V-8 juice. PDA was superior for ascospore production.

Ascospores were obtained by mixing a loop of conidia of each of the mating types on PDA, or by placing cylinders (5 x 7 mm), cut from actively growing cultures of the two mating types 20-25 mm apart on slides covered with a thin layer of PDA.

Material for photography was stained with 0.012 or 0.024 percent crystal violet. These solutions usually only enhanced contrast but sometimes the spores stained preferentially so as to appear dark (Fig. 2). Actually all parts of the spore are hyaline.

Measurements of the ascus include only the main body of the mature ascus. Usually this included the part immediately surrounding the spore because this is the part that is visible (Fig. 2). Gametangial remnants or parts of asci with special shapes, e.g. Fig. 1 B, were not included in the dimensions. At least 100 spores, hyphae, gametangia, and asci were measured at 1200 X.

The need for vitamins was determined by placing a single conidium from an aerial chain on the test medium. Pathogenicity was tested by methods given previously (Butler *et al*. 1965).

One of the cultures of Galactomyces reessii used in this study, originally received from J. P. van der Walt, was obtained from Professor Herman Phaff, University of California, Davis. Two other cultures of G. reessii (Fig. 3, E) were isolated from soil in Puerto Rico. The ability of G. citri-aurantii (6 isolates), G. geotrichum (3 isolates), and G. reessii (3 isolates) to assimilate carbon compounds was tested using media and methods given by J. P. van der Walt and D. Yarrow (1984).

TAXONOMY

Galactomyces citri-aurantii sp. nov. E. E. Butler

Mycelium septatum, hyalinum, dichotome ramosum, 5-9 µm dia. Forma ascorum praecessa a fusione gametangiorum, quae ut rami hyphales 2.5-4.0 x 4-50 µm oriuntur, apice tumescentia ut fiant clavata aut globosa, unum gametangium saepe maius, deinde bina fusionem facientia ut ascos forment. Asci hyalini hemisphaerici, piriformes aut globosi, septis ab hyphis separati. Asci 8-12 x 7-9 µm, singillatim aut in greges conferti. Ascosporae 5-7 x 7-9 µm, hyalinae, subglobosae, late ellipsoideae aut globosae cum lobis hemisphaericis 2.5-5.0 x 1.2-2.5 µm. Sporae uniguttulatae cum canalibus brevibus linearibus, 0.4 x 1.0-4.0 µm in dissepimento externo sporae. Fungus heterothallicus.

D-glucosum, D-glactosum, L-sorbosum, D-xylosum, D-mannitolum, D-glucitolum, ethanolum, glycerolum, ribitolum, DL-acidum lacticum, acidum succinicum assimilatur. Maltosum, saccharosum, cellobiosum, lactosum, melibiosum, raffinosum, melezitosum, trehalosum, inulinum, amylum solubile, L-arabinosum, L-rhamnosum, L-erythritolum, ducitolum, D-arabitolum, salicinum, glucono-δ-lactonum, 2-ketogluconatum, D-glucosoaminum, 5-ketogluconatum, acidum citricum et i-inositolum non assimilantur.

Fermentatio D-glucosi nulla.
Arbutinum non finditur.
Assimilatio potassii nitrati et sodii nitriti nulla.
Necessariae ad crescentiam sunt vitaminae externae.
Habitat in speciebus citri fructum putrefaciens, et in solo sub speciebus citri.
Distributio per orbem terrarum.

Anamorphe: Geotrichum citri-aurantii (Ferraris) Butler comb. nov.
Basionymon: Oidium citri-aurantii Ferraris. Malphigia 13:379. 1899.

Mycelium septate, hyaline, dichotomously branched, 5-9 µm in diameter. Ascus formation preceded by fusion of gametangia (Fig. 1F) which arise as hyphal branches (Fig. 1D), 2.5-4.0 x 4-50 µm, swelling at the apex and becoming clavate or globose, then fusing in pairs (Fig. 1F) and forming asci (Fig. 1B, E, J, K), one gametangium often larger (Fig. 1B, C, J). Whereas the gametangia may be indeterminate in length, they are commonly 4-15 µm long depending upon the distance between the participating hyphae. Asci hyaline, hemisphaerical, piriform, 8-12 x 7-9 µm, separated from hyphae by septa (see arrows Fig. 1B, G), formed singly or in clusters (Fig. 1J, K). Ascospores formed singly, 5-7 x 7-9 µm, hyaline, subglobose, broadly ellipsoidal, or globose with narrow to broad lobes 2.5-5.0 x 1.2-2.5 µm (Fig. 2D, F, G, I). Spores uniguttulate with short linear grooves, 0.4 x 1.0-4.0 µm, on the outer spore wall (Fig. 2F, G, H).

Holotype: A mating of isolate 220 (A_1 mating type) from soil in an orange orchard near Salisbury, Zimbabwe and 178 (A_2 mating type) from soil in an orange orchard in Tulare County, California (see Butler et al. 1965). A dried PDA culture has been desposited in the herbarium of University of California, Berkeley (Accession No. 1475056). Ascospores are distributed over the entire colony.

Living cultures have been deposited at the American Type Culture Collection, Centraalbureau Voor Schimmelcultures, and Commonwealth Mycological Institute.

OBSERVATIONS

COLONY CHARACTERISTICS

Twenty-four isolates (11 A_1 mating types and 13 A_2 mating types) were evaluated on PDA at 25C. Most colonies were thin, dull, grayish-white (Fig. 3), and very finely striate. Mean daily growth rate (MDGR) was 11-12 mm. Conidia were borne in slime. Culture 178 was typical (Fig. 3G). The colonies of two isolates were bright white with a MDGR of 9.5 mm; they did not require pyridoxine for growth. Holotype isolate 220 had a MDGR of 10.5 mm and a bright white colony. The MDGR of 11 cultures of G.

reessii was 6.5 mm (Fig. 3I) and of 3 cultures of *G. geotrichum*, 10.5 mm (Fig. 3H). Characteristics of colonies from the carbon assimilation tests seemed to have potential in the identification of species of *Galactomyces*. In figure 3A, the carbon source is glycerol. Whereas the colony of *G. citri-aurantii*, the largest of the three with arrows, has no special differentiating features, the other two, *G. reessii*, are distinctive. They are enlarged in figure 3D, E, F. In Figure 3B and C, the three species of *Galactomyces* can easily be distinguished on the basis of colony morphology.

PATHOGENICITY

Citrus fruit inoculated with *G. citri-aurantii* developed a sour smelling watery rot. *Galactomyces reessii* and *G. geotrichum* were non-pathogenic to citrus fruit.

SEXUALITY

Galactomyces citri-aurantii is heterothallic; two mating types, A_1 and A_2 are recognized. *Galactomyces reessii* is homothallic, but single conidia may give rise to self-sterile cross fertile cultures, i.e., A_1 and A_2 mating types (Butler and Petersen 1972). When these types (*G. reessii*) were paired, typical ascospores were formed but A_1 and A_2 types did not interact at all with A_1 and A_2 of G. *citri-aurantii*.

On the contrary, PR47A_1 and PR47A_2 cultures of *Galactomyces geotrichum* (Butler and Petersen 1972) did react with A_1 and A_2 mating types of *G. citri-aurantii* as follows. When PR47A_2 and *G. citri-aurantii* A_1 were paired, what appeared to be gametangia were formed on the hyphae of PR47A_2, but no ascospores were formed. The pairing of PR47A_1 with *G. citri-aurantii* A_2 led to the formation of a few ascospores but they were highly variable in form, resembling the parents, or intermediates. They were unsatisfactory for purposes of

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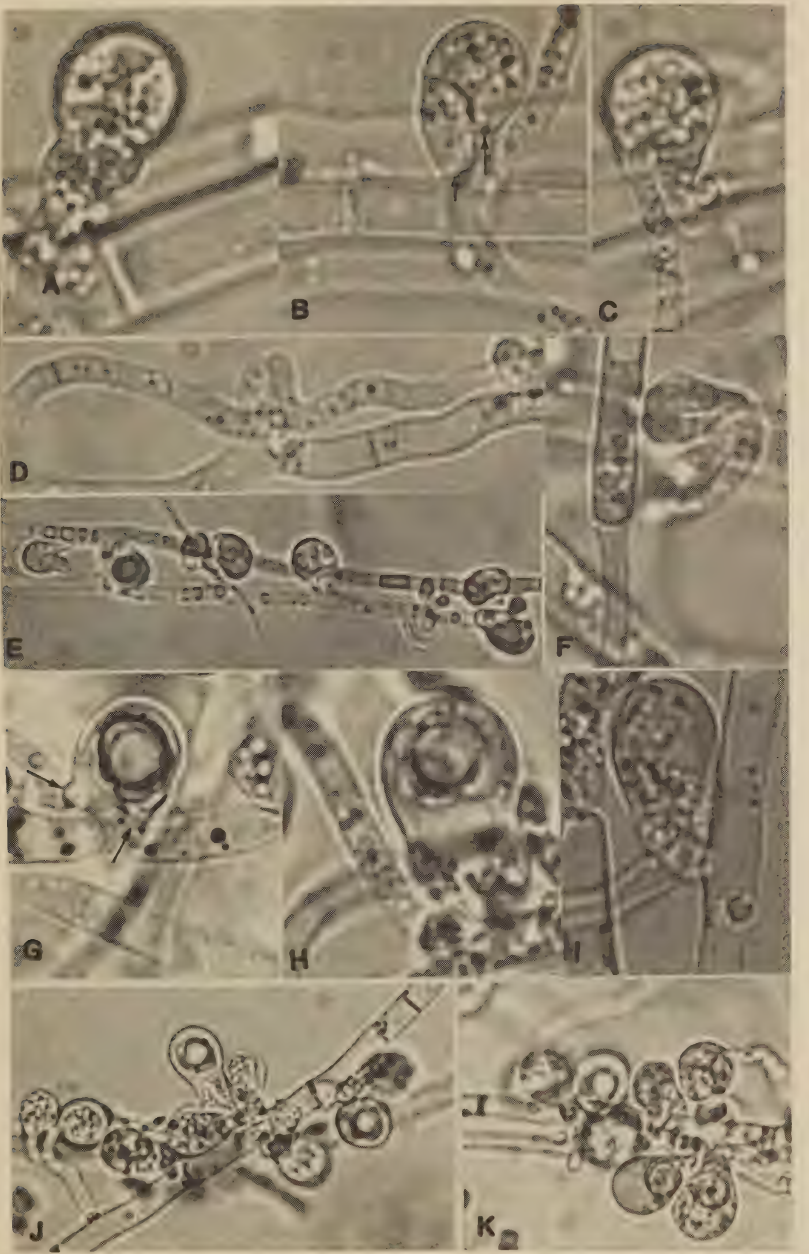
Figure 1. *Galactomyces citri-aurantii*. A, B, C, G, I. Young ascus, X1500; D. Gametangia preceeding fusion, X1000; E. Two parallel hyphae of opposite mating types, X60; F. Gametangia soon after fusion, X1000; H. Young ascus with developing spore, X2000; J, K. Clusters of developing asci, X550.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taxonomy. The results of these studies will be published elsewhere.

PROOF OF SEXUAL NATURE OF ASCOSPORE

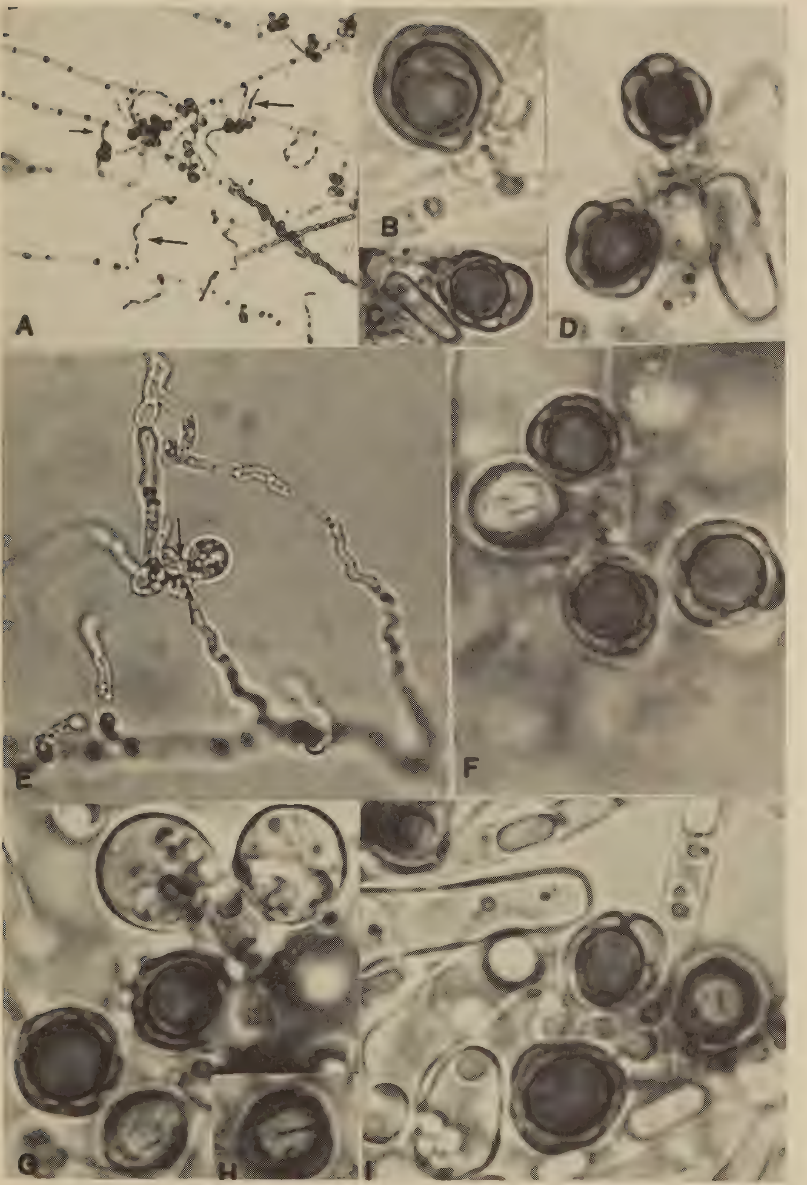
In the beginning of this work we assumed that what we referred to as gametangia were structures that carried nuclei destined to participate in meiosis and that the ascospores described contained the first meiotic products. Proof that this condition prevailed was obtained as follows. The type cultures, 220 [A_1 mating type with long conidia ($\bar{x}$ = 16.5 μm) designated C_1] and 178 [A_2 mating type with short conidia ($\bar{x}$ = 6.0 μm) designated C_2] were grown together on PDA. From this mating 10 single ascospores were selected at random and a colony established from each. Cultures were established from 10 single conidia isolated from each of these colonies--a total of 100 cultures. The mating type of these cultures was determined by back mating to 178 and 220.

From the 10 ascospores four types of cultures were obtained: 3 A_1C_1, 2 A_1C_2, 2 A_2C_1, and 3 A_2C_2. All of the progeny from a single ascospore appeared the same, i.e., each of the 10 single conidia cultures from each ascospore colony were alike in mating type and conidial characteristics. Thus, meiosis occurred prior to ascospore formation, presumably in the young ascus or in the gametangium. The experiment was repeated with compatible cultures from Israel. Segregation was 1:1 for mating type.

ECOLOGIC ISOLATION

Galactomyces citri-aurantii appears to be confined to

Figure 2. *Galactomyces citri-aurantii*. A. Clusters of ascospores and two kinds of hyphae, large main hyphae and narrow hyphae that may act as gametangia, X100; B. Mature ascus and ascospore with remanants of two gametangia. From lemon fruit, X2000; C. Right, ascospore with enlarged lobe, left, conidium, X1400; D. Conidium, mature ascospores and asci (arrows), X1400; E. Developing ascus with gametangia X550 (arrows); F. Ascospores, one spore with grooves (arrow) on outer wall, grooves also seen in G, H, and I, X1500; G. Four mature and two very young asci, X1200; H, I. Mature ascospores showing lobes and surface wall grooves.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the citrus environment. We have screened more than 200 soils supporting vegetation other than Citrus spp. The results are uniformly negative for G. citri- aurantii. On the other hand the species was present in soil under citrus trees and on parts of citrus trees, e.g., leaves. Thus, G. citri-aurantii seems to be ecologically as well as genetically isolated.

OCCURRENCE OF MATING TYPES AND TELEOMORPH IN NATURE

The present study is based upon mating types of the teleomorph from North America, South America, Central American, Asia, Africa, and Europe. In many cases we have found the A_1 and A_2 mating types in soil under the same tree. Ascospores were observed twice in tissues of decaying lemon fruit in northern California.

ASSIMILATION OF CARBON COMPOUNDS, OTHER DIAGNOSTIC CRITERIA

Galactomyces citri-aurantii differed sharply from G. reessii and slightly from G. geotrichum in the pattern of utilization of selected carbon compounds. The results are given in Table 1 and following.

Figure 3. Colony morphology and carbon assimilation tests. Colonies of Galactomyces spp. after 14 days at 25 C on Difco Yeast Nitrogen Base (A-F) and after 4 days on PTA (G,H,I). A. glycerol; B. D-glucose with amino acids deleted; C. Sorbose; D,E, and F, enlarged from dish A (see arrows); G,H,I colonies on PTA after 4 days 25 C (see methods section).

Each of the petri dishes (A-C) inoculated in the same order, have an outer ring of 10 colonies and an inner group of five. Counterclockwise, starting with the colony to the right of letter label: 1,2,3 are G. reessii (no growth on C where the first inoculation point was at the site of the arrow); 4, 5, 6 are G. geotrichum; 8 is an undescribed species of Galactomyces (see text); 7, 9, 10 are G. citri-aurantii. The inner group of 5 colonies can be identified from petri dish B where the dull grayish colonies are G. citri-aurantii. The other 2 dense white colonies of that group are the undiscribed species. D, E and I are G. reessii; F and G are G. citri-aurantii; H is G. geotrichum.

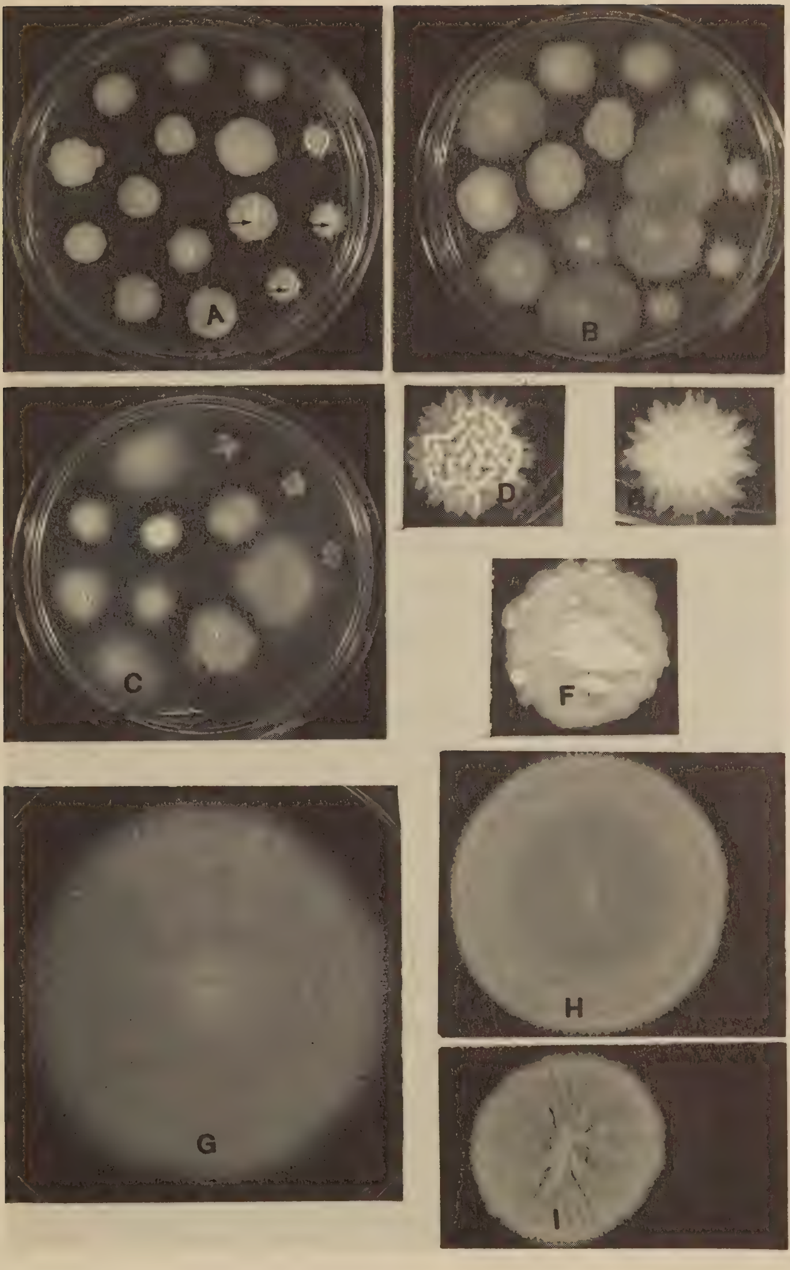
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Table 1. Results of assimilation tests of 13 carbon compounds by three species of Galactomyces.

Compound	G. citri-aurantii	G. geotrichum	G. reessii
glucose	+[1]	+	+
sorbose	+	+s	-
galactose	+	+	+w
D-xylose	+	+	+w
D-ribose	+	+	-
ethanol	+	+	+
D-glucitol	+	+	+w
L-arabitol	+	+s	-
D-mannitol	+	+	-
glycerol	+	+	+
ribitol	+	-	-
lactate	+	+	+
citrate	+/-	-	-

[1] + = growth good; +w = growth weak, colony small, thin; +s = growth slow, colony dense, +/- = growth or no growth, - = no growth. Adapted from J. P. van der Walt and D. Yarrow (1984).

Additional compounds not assimilated by any of the species in Table 1: maltose, sucrose, cellobiose, lactose, melibiose, raffinose, melezitose, trehalose, inulin, soluble starch, L-arabinose, L-rhamnose, L-erythritol, ducitol, D-arabitol, salicin, glucono-δ-lactone, 2-ketogluconate, D-glucosamine, 5-ketogluconate, inositol.

Other characteristics of G. citri-aurantii: Fermentation of glucose, negative; nitrate and nitrite assimilation, negative; splitting of arbutin, negative; vitamin required for growth, pyridoxine; biotin and thiamine stimulated growth.

DISCUSSION

In selecting a name for the teleomorph of the citrus sour rot fungus, the combination Galactomyces reessii var. citri-aurantii was considered. It seemed that such a combination would reflect the similarities of the ascospore morphology of G. reessii and the new teleomorph and also suggest the special association of the latter with Citrus spp. However, we rejected a varietal concept in favor of G. citri-aurantii because in our view there is no overall close relationship of the latter to G. reessii. In fact, as already pointed out in this paper, G. reessii and G. citri-aurantii possess anamorphs different in morphology and growth characteristics and have major differences in physiology, including pathogenicity, and the assimilation of certain carbon compounds (Table 1). In addition, G. citri-aurantii is restricted to citrus plantings. The ecological niche of G. reessii is unknown. We have found it in the citrus environment and elsewhere.

When Galactomyces geotrichum was first described (Butler and Petersen 1972), the first author was aware of the extensive variation known for the anamorph Geotrichum candidum. It seemed unlikely that this one teleomorph, Galactomyces geotrichum, actually represented a single anamorphic, species with its wide diversity of colony types, pathogenicity to plants and animals, habitats, carbon assimilation patterns, etc.

Evidence to support this view is already apparent. In this paper we have described G. citri-aurantii and in addition we have in our collection of recently isolated cultures at least one additional undescribed species of Galactomyces with an anamorph that appears to be Geotrichum candidum (Fig. 3; referred to in legend as "undescribed species"). We expect to treat these isolates as we have treated Galactomyces citri-aurantii, i.e., we recognize the concept that biological as well as morphological features may be the main factors in delimiting teleomorphic as well as anamorphic species in the Galactomyces-Geotrichum group. Stable criteria in the following categories should be considered: morphological, biochemical, ecological, genetical, physiological, and ability to cause disease. De Hoog et al. (1986) have largely followed this procedure in their recent revision of the genus Geotrichum. They have also brought together nuclear DNA base compositon data in G. candidum and Galactomyces reessii.

Whether or not parameters such as mol % guanine + cytosine or DNA/DNA reassociations found valuable in the classification of yeasts are of value in the taxonomy of Galactomyces remains to be determined. In our view the key to understanding relationships in the Geotrichum candidum complex and perhaps all Geotrichum species is to pursue studies that may lead to the production of the teleomorphs. When substantial progress is made in this area along with knowledge of the other potential species criteria, then perhaps DNA studies designed to show relatedness will have more direction. At present, they seem not be be of practical value.

As new teleomorphs are discovered, the anamorphs, if then included in *Geotrichum candidum*, could be renamed to have the same epithet as the new *Galactomyces* or whatever new sexual-state species name is involved. In effect this would narrow the concept of *G. candidum*. To retain the anamorphic name in *Geotrichum candidum* would not be helpful. Under some conditions an unknown isolate cannot be induced to form ascospores when paired with known fruiting types. In such cases the anamorphic name would be useful.

Lastly, if the idea that a single anamorphic species can be related to only one teleomorph is accepted, it becomes necessary to erect a new anamorphic name for the former *G. candidum* isolates now associated with the new teleomorph as illustrated by *Galactomyces citri-aurantii* - *Geotrichum citri-aurantii*.

In addition to the need for a workable approach to speciation is the need for studies of the teleomorphs with transmission and scanning electron microscopes. Whereas there is evidence that the ascospore of *Galactomyces geotrichum* is structurally different from *G. reessii* (Butler and Petersen, 1972; Butler, unpublished), the spore structure of *G. reessii* is unclear. Consider the illustrations of the holotype by van der Walt (1959), Sugiyama *et al*. (1983), De Hoog *et al*. (1986), and spores of *G. citri-aurantii* in figure 2 herein. Our culture of *G. reessii* from H. Phaff has spores very similar to those illustrated in our figure 2. They show the spore to be lobed. The illustrations of De Hoog *et al*. (1986) are morphologically similar. But the drawings of van der Walt (1959) and Sugiyama *et al*. (1983) show a roughened sheath around the spore. Van der Walt refers to it as a "creased membrane." If these sketches truly represent *G. reessii*, then our cultures of *G. reessii* may belong to another species.

ACKNOWLEDGMENTS

This research was supported by the University of California and by a grant from the United States-Israel (Binational) Agricultural Research and Development Fund (BARD). The authors thank scientists from around the world for their generous cooperation in supplying citrus soils and information pertaining to these investigations, to Drs. R. K. Benjamin and J. Adaskaveg for many helpful suggestions, and to Dr. Peter Schaeffer, Department of German and Russian, University of California, Davis for preparing the Latin Description.

KEY WORDS

Hemiascomycetes, Endomycetales, Dipodascaceae, *Galactomyces citri-aurantii*, *Galactomyces reessii*, *Geotrichum citri-aurantii*, citrus sour rot.

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NEW SPECIES OF INOCYBE FROM SOUTHERN CALIFORNIA

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SUMMARY

Three new species of *Inocybe* with smooth spores are described from southern California (*Inocybe chrysocephala*, *I. menthi-gustans*, and *I. hemileuca*), the last also occurring in Washington state.

Knowledge of the genus *Inocybe* in North America is limited if compared to that in Europe, where hundreds of species have been described since those of Fries (1821). Several mycologists undertook taxonomic studies of the genus in the twentieth century, including G. Massee, J. E. Lange, J. Boursier, R. Kuhner, and R. Heim. SEM studies of *Inocybe* spores were done by D. Pegler and T.K. Young (1972), J. Stangl provided several studies on the nodulose - spored species (1975 - 1979), and C.L. Alessio (1980) and T.W. Kuyper (1985, 1986) monographed the genus, focusing on European species. North American mycologists, C.H. Peck, G.F. Atkinson, C. H. Kauffman, and W.A. Murrill described some 160 new species and varieties of *Inocybe* between 1871 and 1945, mostly with very brief protologues and scant details (Nishida, 1987). The majority of these new species were from the eastern United States, as far west as Michigan.

The first *Inocybe* descriptions from America with details of microscopic features were given by D.E. Stuntz (1947), A.H. Smith & D.E. Stuntz (1950) in their reports of fungi from the Pacific northwest, and by Stuntz (1954) on Michigan inocybes. D.W. Grund & D.E. Stuntz (1968-1984) reported 70 taxa of *Inocybe*, describing 23 new species or varieties, from the small but mycologically rich region of Nova Scotia, in eastern Canada. The genus has been little studied in the vast majority of the forested regions of North America, outside of eastern North America and the Pacific coast state of Washington. The only key to North American species widely available is that of C.H. Kauffman (1924) and Nishida (in press). Furthermore, the comprehensive revision by Kuyper (1986) of the genus (in Europe) treats only the smooth-spored species and generally omits discussion of North American inocybes.

The new taxa of *Inocybe* presented here are the result of an investigation of the genus in southern California, primarily as it occurs in the *Quercus agrifolia* ("coast live oak") woods (Nishida, 1987). Although within a semi-arid region with Mediterranean climate, i.e., of warm, dry summers and cool, moist winters (average annual precipitation of 14"), these *Quercus agrifolia* woods occur in a foggy, coastal belt and support a considerable agaric flora in the winter, including at least 30 species of *Inocybe*.

Color terms used in the descriptions are from Kornerup & Wanscher, Methuen Handbook of Color, and are designated thusly: 7D8. Collections cited with "FHN" field numbers are deposited in LAM, the herbarium of the Natural History Museum of Los Angeles County. Collections cited with "HDT" for Harry D. Thiers, unless otherwise noted, were borrowed from SFSU. Herbaria acronyms cited are identified in Holmgren et al. *Index Herbariorum*, Part I, 7th edition. Microscopic examination were made of specimens, mounted in 5% KOH for fresh material and with a pre-treatment in 95% Etoh for dried material. No significant differences were seen in spore or cystidia measurements of the same specimen due to the two treatments.

Inocybe chrysocephala Nishida, spec. nov. - fig. 1

Pileus 12-25 mm latus, hemisphaerico-convexus vel lato-conicus, sine umbone, glaber, radialiter fibrillosus, primo bicolorus, centro aurantiaco-brunneus et margine aureus, dein pileus totus aureus; caro alba, immutabilis. Lamellae primo pallidae, dein obscure brunneae haud olivaceo-brunneae. Stipes 35-60 x 3-6 mm, aequalis, pallide luteus, basi haud bulbosus, omnino pruinosus, caro pallida, immutabilis. Odor subnullus. Sporae (8.5-9.0-) 10.0-11.0 x 5.5-6.0 um, Q = 1.8, laeves, amygdaliformes, apice subconico. Pleurocystidia (37-)56-60 x 16-18 um, fusiformia, parietibus valde crassis, pallidis vel distincte luteis. Cheilocystidia pleurocystidiis similia. Caulocystidia descendentia ad basim, cheilocystidiis similia. Holotypus in LAM: F.H. Nishida 2487, 30 Dec 1983, El Cariso, Riverside County, California, U.S.A.

PILEUS 12-25 mm broad (cap:stipe = 0.3), hemispherical-convex to broadly conical, margin long remaining decurved, becoming only slightly arched in maturity; obtusely umbonate upon drying; pileipellis very smooth, appressed fibrillose, or rarely, becoming finely squamulose-scaly upon drying, especially on the crown, not revolute fibrillose, nor rimose; golden-orange, with a bicolorous appearance when fresh and wet, the disc darker, due to a concentration of orange-brown (7D8) fibrils, the same fibrils lending a golden (4A8) tone to the marginal area covered with yellow fibrils, the entire pileus gradually becoming unicolorous, yellow brown to fulvous brown (5A8, 5B7) after drying; context white, unchanging. LAMELLAE moderately crowded, narrowly adnate, pallid, becoming light tan, to medium ferruginous brown, not olivaceous, with white fimbriate margins. STIPE 35-60 x 3-6 mm , long and slender (cap:stipe = 0.34 - 0.41), pale yellow (2A3), becoming darker yellow (3A3) with handling, nearly concolorous with pileus when dried, smooth, surface pruinose over entire stipe, context white, unchanging, base equal or slightly enlarged, not bulbous. ODOR none or very slight, similar to fresh corn.

SPORES (8.5-9-)10-11 x 5.5-6 um (mean Q=1.8), variable in size within a single specimen, with numerous obviously larger spores (12.5-14 x 6.5 um), smooth, amygdaliform, to sublimoniform or elongated and nearly ellipsoid, with bluntly pointed apex and a distinct hilar appendage. Only tetrasporic basidia found. PLEUROCYSTIDIA (37-)56-60 x 16-18 um, extremely abundant, fusoid, never lageniform, neckless, with distinct pedicels, very thick-walled (4 um) to the base, pale to moderately bright yellow, with abundant crystals at the apex. CHEILOCYSTIDIA abundant, similar to pleurocystidia, along with short, thin or thick-walled, clavate paracystidia. CAULOCYSTIDIA on the stipe apex in dense clusters, clavate to sub-cylindrical, thick-walled; at the base, in scattered clusters of thick and thin-walled sub-cylindrical cystidia. PILEIPELLIS, over the disk, an interwoven cutis of branching, pigment encrusted hyphae, over the marginal area, of more or less parallel, radially arranged pigmented hyphae. REFRACTIVE HYPHAE found in the upper stipe.

Gregarious in grassy open area near Quercus agrifolia, coastal mountains, winter, southern California. Known only from southern California.

Collections examined: FHN 2487 , El Cariso, Riverside Co., CA., 30 Dec 1983 (Holotype: LAM 253363); GW 1348, Santa Ynez Cyn, Los Angeles Co., CA., 9 Mar 1979, coll. G. Wright. Similar collections also examined: FHN 3639, El Cariso, Riverside Co., CA., 7 Jan 1987, coll. B. Silver (is I. hirtella); HDT 30580, Nevada Co., CA., 11 Nov 1972 (is I. hirtella); HDT 47105, Humboldt Co., CA., 25 Nov 1983 (I. auricoma); HDT 14529, Humboldt Co., CA., 8 Dec 1965; HDT 18425, Mendocino Co., CA., 8 Jan 1967 (I. Kauffmanii); FHN 3976, Riverside Co., CA., 8 Mar 1980, coll. G. Wright 1815 (I. menthi-gustans Nishida); HDT 14697, Mendocino Co., CA., 19 Jan 1966 (I. ochraceomarginata); HDT 10031, 5 Jan 1963; HDT 28573, 4 Dec 1971; HDT 24456, 6 Dec 1969; HDT 49279, 23 Nov 1985; HDT 9798, 20 Dec 1962 (all Mendocino Co., CA.); HDT 30802, Sonoma Co., CA., 25 Nov 1972; HDT 45773, Marin Co., CA., 13 Jan 1983; (all I. subochracea); HDT 17307, Amador Co., CA., 7 July 1966, (I. vaccina).

This species is distinctive by its combination of bright pileal colors, pale yellow (never incarnate) stipe, small, slender habit, reminiscent of Marasmius or Panaeolus and its suite of microscopic characters: short, extremely thick-walled, pale to distinctly yellow pleurocystidia, presence of caulocystidia along the length of the stipe, and amygdaliform spores with conical apex. In California, several species superficially resemble #2487 by their bright colors (ochraceous yellow, tawny, "sayal brown," "buckthorn brown") and very thick walled cystidia. I. subochracea (Pk.)Pk and the larger I. olympiana A.H. Smith both have bright yellow cystidia and smaller spores. I. ochraceomarginata Kauffm. has hyaline to pale yellow cystidia, but a scaly to squarrose pileipellis, and all three have only apical caulocystidia. I. Kauffmanii A.H. Smith has basal caulocystidia, but hyaline pleurocystidia, smaller spores, and a larger (30-60 mm) and paler (nearly white) pileus.

Among brightly colored European species: I. auricoma (Batsch) J. Lange has only apical caulocystidia; I. hirtella Bres. and I. mycenoides Kuyper have similar statures, but also ochraceous stipes with occasional reddish tinges, smaller spores, and the former usually has an almond odor, while the latter has sulfur yellow lamellae and thinner walled, pale yellow pleurocystidia; I. hirtelloides Stangl & Veselsky has colorless pleurocystidia, and cheilocystidia dissimilar to its pleurocystidia; I. vaccina Kuhn. has a very short stipe, a darker, fulvous pileus, and smaller spores.

Inocybe menthi-gustans Nishida, spec. nov. - fig. 2

Pileus 38 mm latus, leniter convexus, sine umbone, glaber, sericeus, albidus vel ochroleucus, caro pilei alba. Lamellae primo pallidae, dein avellaneae. Stipes 120 x 9 mm, longus, albescens, aequalis, basi haud bulbosus, omnino pruinosus, caro lutescens in parte superiore, alba in parte inferiore. Odor spermaticus, sapor menthae dein acer. Sporae 9.0-10.0(-12.5) x 5.0-5.5(-6.5) um, Q = 1.5-2.5, laeves, ellipticae vel subfabiformes, apice obtusato. Pleurocystidia (45-)50-56(-65) x 11-12.5 um, rarissima, claviformia vel subfusiformia et flexuosa, cum apice obtusato, pariete conspicuo crasso, paries 4-5.5 um crassus, hyalinus. Cheilocystidia frequentes, pleurocystidiis similia. Caulocystidia descendentia ad basim, cheilocystidiis similia, pariete crasso in parte superiore, oblonga vel cylindrica, pariete tenui in parte inferiore. Holotypus in LAM: FHN 3976, 8 Mar 1980, El Cariso Campground, Riverside Co., California, USA, coll. G. Wright 1815.

PILEUS 38 mm broad (cap:stipe = 0.3), shallowly convex, its margin remaining decurved after expansion, exumbonate; pileipellis smooth, silky, innately fibrillose, not rimose, white to light ochraceous (3A2, 4A3), without an obvious velipellis; context "cinnamon" (6D6) beneath the pellis, otherwise white. LAMELLAE "hazel" brown (6E8) with

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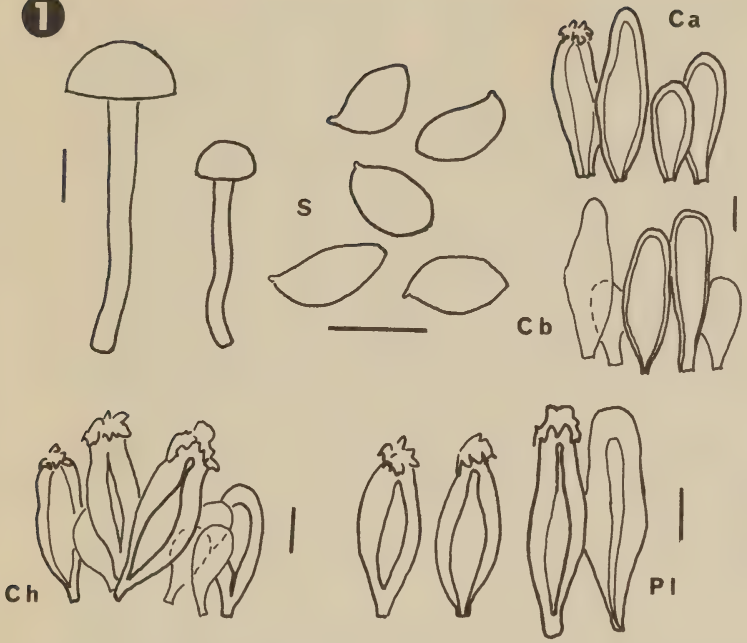
Fig. 1. Inocybe chrysocephala(Holotype, FHN 2487).
Fig. 2. Inocybe menthi-gustans (Holotype, FHN 3976).
For all figures in this paper: Pl = plurocystidia, Ch = cheilocystidia, Ca = apical caulocystidia, Cb = basal caulocystidia, S = spores. Bar represents 10 um for microscopical features, 1 cm for habit drawing.

1



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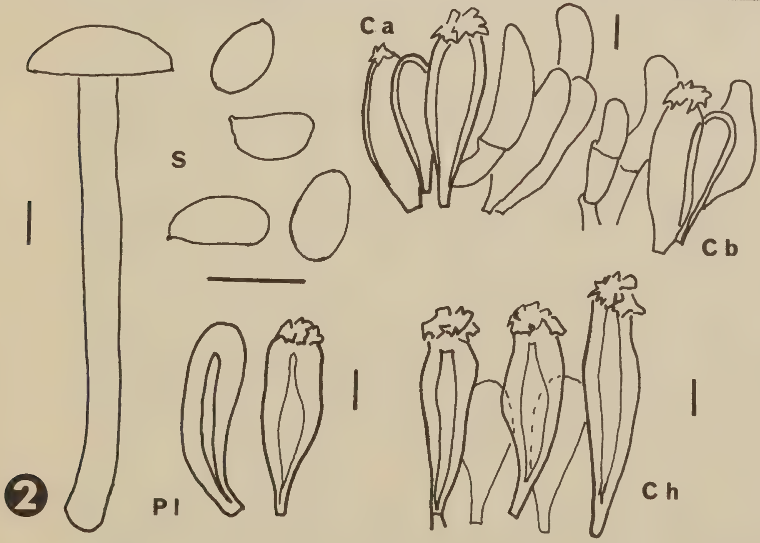

maturity, moderately crowded, narrowly adnate, ventricose, moderately broad (4.5-5.5 mm), white slightly flocculose-fimbriate. STIPE 120 x 9 mm, long, white with some ochre, silky-striate, entirely pruinose, tapering downward to a slightly swollen, but not bulbous base covered with white mycelium, context white, very pale yellow in upper region. ODOR faintly spermatic; TASTE mild at first, becoming "warm and minty" and finally acrid.

SPORES 9.0-10.0(-12.5) x 5.0-5.5(-6.5) um, (Q=1.5-2.5, mean Q=1.8), smooth, variable in size, elliptical to subreniform, with a rounded apex and distinct hilar appendage. PLEUROCYSTIDIA (45-)50-56(-65) x 11-12.5 um, very rare, clavate to subfusiform, never lageniform, with somewhat flexuous outline, neckless, with an obtuse apex, and extremely thick, hyaline walls (4-5.5 um). CHEILOCYSTIDIA frequent, similar to pleurocystidia, thick-walled, hyaline, with abundant crystals at the apex; PARACYSTIDIA thin-walled, narrowly clavate. CAULOCYSTIDIA at the stipe apex, thick-walled, clavate to fusoid, in clusters with versiform paracystidia; at the stipe base, less frequent, more thin walled, oblong-cylindrical, mixed with paracystidia and cystidiod hairs. PILEIPELLIS a tangled cutis of pale yellow hyphae, without obvious clamps. REFRACTIVE HYPHAE found in pileus trama.

Solitary in leaf litter of Quercus agrifolia, spring, coastal mountains, southern California. Known only from the type locality.

Collections examined. FHN 3976, El Cariso, Riverside Co., CA., 8 Mar 1980, coll. G. Wright 1815 (Holotype). Similar specimens examined: HDT 14529, Humboldt Co., CA., 8 Dec 1965; HDT 18425, Mendocinco Co., CA., 8 Jan 1967 (are I. Kauffmanii).

The combination of very pallid colors (white to pale ocre) with microscopical characters of elliptical spores and extremely thick-walled, hyaline cystidia, and the unusual quality of a minty to acrid taste (reported by the collector), make this species unique. In coloration, it resembles: I. Kauffmanii A.H. Smith, which however, has fusoid-ventricose pleurocystidia and amygdaliform spores; I. geophylla and I. insinuata, which lack basal caulocystidia; and I. sindonia, with a long stipe, but also with smaller spores and long, narrow, cylindrical to fusiform cystidia with pale to bright yellow walls. I. ochroalba has broadly clavate cystidia with pale yellow, moderately thick walls and smaller, subamygdaliform spores. I. cylindrocystis Atk. and I. cryptocystis Stuntz, both ochraceous, with short, cylindrical to clavate, but thinner-walled pleurocystidia, have only apical caulocystidia. None of these species has an acrid or minty taste.

Despite there being only a single collection, I. menthi- gustans appears to be a good species, previously unreported. It may have gone unrecognized, as an acystidiate species, because the pleurocystidia are short, colorless, and very rare, thus easily overlooked. The collector, G. Wright, had noted "pleurocystidia absent."

Inocybe hemileuca Nishida & Stuntz, spec. nov. - fig. 4

Pileus 30-40 mm latus, convexus vel lato-conicus, umbone obtuso, glaber, aurantio-brunneus cum disco albido propter velum crassum. Stipes 30-34 x 5.0-7.0 mm, sericeus, brunneus et incarnatus vel salmoneus, aequalis, basis bulbosa et marginata. Odor spermaticus. Sporae grandes, 11.5 - 13.5(-14) x 6 - 7 (-7.5) um, Q = 1.7-2.0, mean Q = 1.9, laeves, subamygdaliformes, apice subconico. Pleurocystidia rara, 60-70 x 14-16 um, fusiformia, subventricosa vel oblonga, parietibus modice crassis, hyalinis vel lutescentibus. Cheilocystidia parietibus crassis vel tenuibus. Stipes cystidiis clavatis vel cylindricis ad apicem, sine cystidiis ad basim. Holotypus in LAM: FHN 498, Long Valley, Mt. San Jacinto State Park, 19 June 1980, coll. G. Wright 1997.

PILEUS 30-40 mm broad (cap:stipe = 1.0), obtusely umbonate when expanded; pileipellis smooth, innately fibrillose or slightly diffracted scaly at the margin, orange brown ("cinnamon"), with a white disc due to a thick velipellis; context white. LAMELLAE close, grayish yellow brown, of (6E8), medium breadth with white, fimbriate margins. STIPE 30-34 x 5.5-7 mm, silky, slightly furfuraceous at apex and lower stipe, light brown with reddish to orange tinge, equal, ending in a submarginate bulbous base; context generally white, pale "cinnamon" in the marginal area of the lower stipe. ODOR spermatic.

SPORES smooth, large, 11.5-13.5 (-14) x 6-7 (-7.5) um (Q=1.7-2.0, mean Q=1.9), subamygdaliform to inequilaterally ellipsoid, to limoniform with a blunt, subconical apex. PLEUROCYSTIDIA scattered, hyaline to pale yellow, moderately thick walled (1.0-1.5 um), fusoid-ventricose to oblong-cylindrical or subcapitate (60-70 x 14-16 um) with crystals at the apex. CHEILOCYSTIDIA of both moderately thick walled and thin walled subcylindrical metuloids; thin walled paracystidia also present. Stipe apex with occasional clusters of thin-walled, clavate to cylindrical cystidia. No metuloids at the base. REFRACTIVE HYPHAE in pileus and stipe trama.

Occurring singly or in pairs under conifers. Known only from montane California and Washington.

Collections examined. FHN 498, Long Valley, Mt. San Jacinto State Park, Riverside Co., CA., 19 June 1980, coll. G. Wright 1997 (Holotype); HDT 12691, Lassen Volcanic National Park, near Butte Lake, Shasta Co., CA., 22 June 1965; DES 6238, 6254, 6258 (WTU), Lake Wenatchee State Park, WASHINGTON coll. J. Butner, 27 May, 1951; DES 6264 (WTU), same locality.

Remarks: This moderate sized Inocybe of short, rather stout stature is distinguished by its cinnamon brown pileus, a distinct and persistent white patchy velipellis,

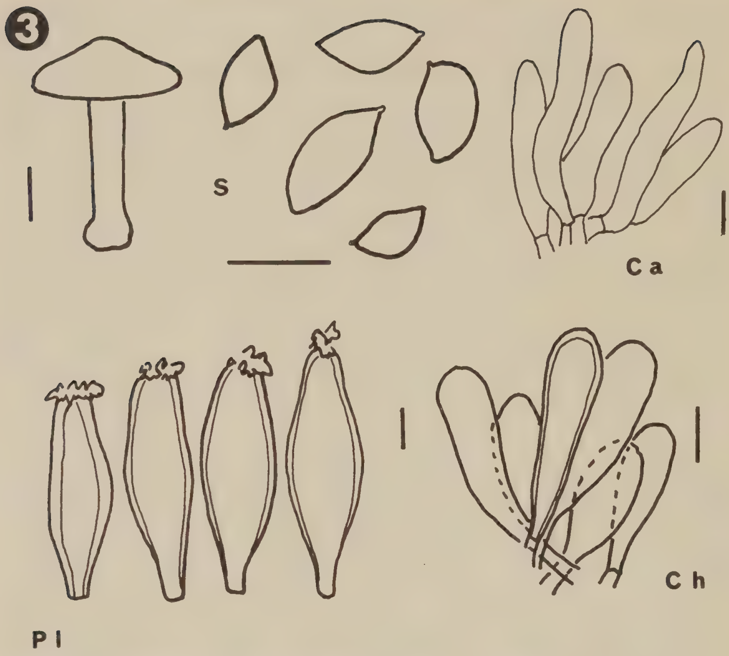

Fig. 3. *Inocybe hemileuca* (Holotype, FHN 498).

an incarnate stipe with a marginate to submarginate bulbous base, fusoid-subventricose pleurocystidia, and large, broad spores ((10-) 11.2 - 12 (-13.5) x (5-) 6 - 7 um, subamygdaliform to limoniform in shape.

Among species with incarnate stipes, this species closely resembles *I. subdestricta* Kauffman, which also occurs in California and is widespread in North America. That species however, lacks the distinct and persistent white patch of velipellis and has smaller spores. *I. pseudodestricta* Stangl & Veselky from Europe, remarkably similar to *I. subdestricta*, also has smaller spores. *I. nitidiuscula* (Britz.) Sacc. as circumscribed by Stangl (1983) and Kuyper (1986) resembles *I. hemileuca* in coloration, but lacks a a well-developed velipellis, is more slender, lacks the marginate, bulbous base, and has generally smaller spores (9.3 -11.3 x 5.5 - 6.6 um).

The epithet "hemileuca" was used by Daniel Stuntz as a provisional name for specimens of three collections made on the same day, in a lodgepole pine or ponderosa pine forest in Washington. DES 6264, also from Washingtion and very similar in microscopic details, is very small (pileus 11-15 mm) and has a cespitose habit. He had applied another provisional name to that collection. But it is probably the same species. Stuntz apparently wanted to find more material of I. hemileuca before publishing a description. We now have collections from northern and southern California (although rare, so far), and interestingly, all the collections were made in coniferous woods, in montane habitats.

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LACCARIA GOMEZII, A NEW AGARIC SPECIES FROM THE QUERCETA OF COLOMBIA AND COSTA RICA

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ABSTRACT

Laccaria gomezii is described from *Quercus* forests in Central and South America. This species is compared to *L. amethystea* (Bull.) Murrill to which it most closely resembles.
Key words: Agaricales, *Laccaria*, Central America, South America, *Quercus*.

Species of *Quercus* comprise a major component of the montane and cloud forests of Colombia and Central America. Associated with these trees are numerous genera of ectomycorrhizal higher basidiomycetes (e.g., Singer, 1963; Singer and Gómez, 1982, 1984; Singer et al., 1983). As in north and south temperate forests, species of *Laccaria* appear to form a significant part of the ectotroph mycota of these areas. Species commonly encountered in these areas include: *Laccaria laccata* (Scop.: Fr.) Berk. & Br., *L. tetraspora* Singer and *L. amethystea* (Bull.) Murrill.

During collecting trips to Costa Rica in July-August 1986 and Colombia in May 1987, several collections of an undescribed species of *Laccaria* were made. Although superficially similar to *L. amethystea*, this new species differed significantly. Another collection of this new species was located in the herbarium at F, provisionally filed under *L. gomezii nom. prov*. With the acquisition of additional collections, we hereby describe *L. gomezii* as new.

Color names within parentheses are from Kornerup and Wanscher (1978). At least 30 measurements per collection were used for calculating basidiospore size data, mean size (= $\bar{x}$) and length-width ratio (= Q). Basidiospore size data here are always given without ornamentation and hilar appendage, with hilar appendage in profile. Likewise, descriptive terms and nomenclature conform with Mueller (1984).

LACCARIA GOMEZII Singer & G.M. Mueller. sp. nov. Figs. 1-3.

Pileo 10-38(-65) mm lato, umbilicato, estrio, fibrilloso vel squamoso-squarruloso, atropurpureo vel atrovioleo, mox vinaceo-brunneo, siccando brunneo dein alutaceo. Lamellis adnatis vel decurrentibus, tenuibus, concoloribus. Stipite 44-112 x 2-9 mm, striato, pubescente ad apicem, pileo concolori vel dilutiore. Basidiis tetrasporis. Cheilocystidiis magnis, abundantibus. Basidiosporis plerumque 7.5-9.3 x 6.8-8.3 µm (sine ornamentatione), subglobosis vel late ellipsoideis, echinulatis, spinis brevibus vel moderatim longis praeditis.

Type specimen (HOLOTYPE): COSTA RICA: Cartago Prov., along Panamerican Highway at km 55, La Chonta, 2800 m., under _Quercus_ and _Magnolia_, September, 1982, _Gómez_ _18443_ (F # 1051926).

Pileus 10-38(-65) mm broad, convex and often deeply depressed, not striate, finely fibrillose to somewhat fibrillose scaly to squarrose, not rimose nor strongly radially fibrillose, strongly hygrophanous, dark violet purple to dark reddish purple (14-E-4 to 14-F-7), soon changing to vinaceous brown (11-D-4 to 11-D-5, 12-D-4 to 12-D-5), fading brownish (8-C-4 to 8-D-5), then to buff; margin decurved, entire to slightly undulate; context thin, concolorous with pileus surface. **Lamellae** adnate to subdecurrent, crowded to close, thin, narrow to broad, concolorous to slightly lighter colored than fresh pileus (14-D-5 to 14-E-4), not fading. **Basidiospores** white in mass. **Stipe** 44-112 x 2-9 mm, equal to subclavate, dry, longitudinally striate, often pubescent at apex and there occasionally with scattered squamules, often coarsely woolly-strigose at base, when fresh concolorous with pileus, soon fading lighter buff than pileus. **Basal mycelium** violet soon fading to buff.

Pileipellis tightly interwoven with scattered fascicles of ± perpendicular hyphae; fascicles usually composed of 10-30 or more hyphae; terminal cells of fascicular hyphae 10-15 µm diam, elongate, subclavate to elongate-clavate, occasionally strangulate or subcapitate, with walls up to 0.5 µm thick, vinaceous brown in young specimens, light yellowish brown in mature specimens. **Pileus trama** tightly interwoven, morphologically undifferentiated, hyaline to vinaceous brown. **Lamellar trama** of parallel to subparallel hyphae, these mostly 3-8 µm diam, thin-walled, hyaline to vinaceous brown; cells long, barrel-shaped. **Subhymenium** morphologically undifferentiated. **Basidia** 27-43 x 6.5-13.5 µm, clavate, elongate, hyaline; sterigmata 4, up to 8 µm long. **Pleurocystidia** lacking. **Cheilocystidia** (42-)64-86 x 6-11 µm, filamentous to subclavate or strangulate, very abundant, often almost forming a sterile layer, extending well beyond basidia and basidioles, thin-walled, hyaline. **Basidiospores** (excluding ornamentation) (6.5-)7.5-9.3(-9.8) x (5.8-)6.8-8.3(-9.3) µm, $\bar{x}L$ = 8.0-8.7 µm, $\bar{x}W$ = 7.0-7.6 µm,

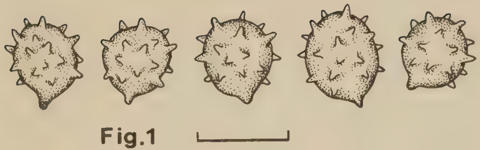

Fig.1

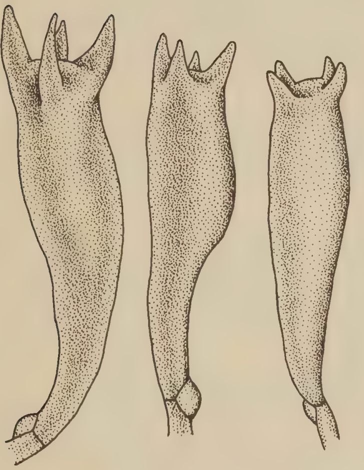

Fig.2

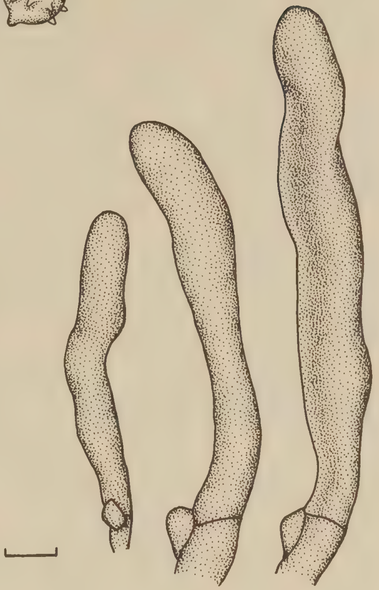

Fig.3

Figs. 1-3. Representative structures from the Holotype of Laccaria gomezii (Gómez 18443). Fig. 1. Basidiospores. Fig. 2. Basidia. Fig. 3. Cheilocystidia. Scale line = 10 μm.

Q = (1-)1.06-1.29, $\bar{Q}$ = 1.13-1.14, subglobose to broadly ellipsoid, very rarely globose, rarely ellipsoid, hyaline, echinulate; spines (0.7-)1-2.5(-3) μm, less than 1 μm wide at base, crowded; hilar appendage 1.3-2 μm long, prominent, truncate; contents occasionally uniguttulate. **Caulocystidia** 34-65 x 7-14 μm, subclavate to clavate, some strangulate, thin-walled, hyaline to light vinaceous brown, formed from recurved surface hyphae, scattered and solitary to clustered in small groups at apex of stipe, absent or very infrequent below. **Clamp connections** at nearly all septa; basidiospores and all elements inamyloid, not dextrinoid, and acyanophyllic.

ETYMOLOGY: Named after L.D. Gómez; the collector of the holotype and noted Costa Rican botanist.

HABITAT AND DISTRIBUTION: Scattered under Quercus in montane and cloud forests in Colombia and Costa Rica.

COLLECTIONS EXAMINED: COSTA RICA: Cartago Prov., along Panamerican Highway at km 55, La Chonta, 2800 m., under *Quercus* and *Magnolia*, September, 1982, *Gómez 18443* (F # 1051926), *holotype*. -- Cartago Prov., Volcán Poás, behind visitor center, path into ravine, 2500 m., under *Quercus*, 29 July, 1986, *G.M. Mueller 2391* (F # 1075835). -- Cartago Prov., along Panamerican Highway, 1.16 km south of Cerro de la Muerte, 2900 m., under *Quercus*, 31 July, 1986, *G.M. Mueller 2417* (F # 1075836). -- COLOMBIA, Depto. De la Huila, Municipio Purace, road between Popayán and La Plata, Finca Merenberg, 2270 m., mixed hardwoods with scattered *Quercus humboldtii*, 21 May, 1987, *G.M. Mueller 2893* (F # 1075834).

OBSERVATIONS: *Laccaria gomezii* is characterized by its purple basidiocarp color that quickly turns vinaceous brown then brown; adnate to decurrent, close to crowded, thin lamellae; and subglobose to ellipsoid, relatively finely echinulate basidiospores.

Laccaria gomezii can be distinguished from *L. amethystea* (= *L. calospora* Singer), with which it grows sympatrically, by its basidiocarp color, lamellar characteristics and more elongate, finer ornamented basidiospores. Fifteen Costa Rican and Colombian *L. amethystea* collections were examined and found to have a $\bar{Q}$ = 1.0-1.04. It differs primarily from *L. amethysteo-occidentalis* G.M. Mueller (= *L. amethystina* (Hudson) Cooke *sensu* Singer) and *L. vinaceobrunnea* G.M. Mueller by its basidiocarp color and lamellar characteristics. For full descriptions of these three species, the only other violet colored *Laccaria* reported from the Americas, see Mueller (1984) and Mueller and Vellinga (1986).

The distribution range of *L. gomezii* is difficult to determine at this time. Since the most southern extension of *Quercus* in the new world is in Colombia, it is probable that this is the southern limit of *L. gomezii*. The *Laccaria* species of east Texas, Louisiana, and Mississippi have been sampled relatively well and our new species has not been observed in that area. Judging by the description of *L. amethystea* from Mexico by Aguirre-Acosta and Pérez-Silva (1978), it is possible the *L. gomezii* may have been included under this name. More work is needed before we can make predictions on the distribution of *Laccaria* within the Querceta that extend from the southern U.S.A. through Colombia.

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THE GENUS *HELVELLA* IN ALBERTA

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Abstract

Collections representing 15 previously described species of the discomycete genus *Helvella* (*H. acetabulum, H. atra, H. brevis, H. confusa, H. corium, H. crispa, H. elastica, H. ephippium, H. lacunosa, H. leucomelaena, H. maculata, H. pezizoides, H. silvicola, H. solitaria,* and *H. villosa*) are described, illustrated and discussed with respect to their taxonomic disposition. *Helvella robusta* sp. nov. is described and illustrated. The new taxon is distinguished from other species in the section *Acetabulum* on the basis of its large size, very robust stipe, medium brown colouration and reflexed apothecial margin. Section *Silvicolae* sect. nov. is described to accommodate the species *H. silvicola*. A key to the species of *Helvella* known from Alberta is provided.

Introduction

Helvella L. : Fr., emend. Nannf. is a large genus of operculate discomycetes that includes a series of species which have cupulate, auriculoid, or irregularly lobed apothecia. Most species are terrestrial and stipitate. *Helvella* is distinguished from other large stipitate discomycetes (e.g. *Gyromitra*) on the basis of ascospore morphology and excipulum structure. With the exception of *H. brevis* which has triguttulate, fusiform ascospores, the ascospores of *Helvella* are broadly ellipsoidal and generally uniguttulate. Asci are cylindrical and contain 8 uniseriate ascospores. Paraphyses are unbranched, sparingly and inconspicuously septate, and slightly swollen at the apex. In thin sections of apothecia, the outer excipulum is visible as a layer which is morphologically distinct from the medullary tissue.

Species of *Helvella* are distinguished on the basis of apothecium shape, and the texture of the excipular surface which varies, according to species, from glabrous to villose. The presence or absence of ribs on the stipe (and, occasionally, on the undersurface of the apothecium), and internal stipe construction (i.e. solid, hollow or chambered) as seen in cross section are important species characters. Pigmentation in the species of *Helvella* is very diverse, ranging from almost white, through numerous shades of brown and grey, to black.

The taxonomy and distribution of the genus has been well-studied in Europe (Dissing 1964, 1966, Dissing and Sivertsen 1980, Eckblad 1968, Häffner 1987, Harmaja

1974, 1976, 1977a, 1977b, 1979, Nannfeldt 1937) but there are fewer reports concerning the occurrence and distribution of the genus in North America (Anderson and Ickis 1921, Dissing and Lange 1967, Groves and Hoare 1953, Kempton and Wells 1970, Weber 1972, 1975) and none of these considers collections from Alberta. In fact, published literature concerning the genus *Helvella* in Alberta is limited to one checklist in which nine species are reported to occur in the province (Larsen and Denison 1978). Due to the wide variation in plant communities in the province, a larger number of species of *Helvella* is expected in Alberta. Extremes in altitude (300 to 3700 metres a.s.l.) and latitude (49 to 60° N) and a wide variety of drainage patterns combine to yield a complex mosaic of habitats and seasonal variations. The growing season or frost free period ranges from 60 days in northern regions to 120 days in the south. Alpine and montane areas can have severe frosts and heavy snowfalls at any point throughout the summer months. For these reasons, it is difficult to compare fruiting times of species found in Alberta with those of other more intensively studied areas. For example, while *H. acetabulum* or *H. leucomelaena* are considered early spring species in Denmark, these species can be found fruiting in July in Alberta. July collections of these species would be most unusual in Denmark (Dissing, pers. comm.).

This paper provides descriptions, illustrations and discussion of fifteen previously described species of *Helvella* based on collections from Alberta. In addition, *H. robusta* sp. nov. is described and illustrated based on two collections made in Alberta. The basionym, and synonyms which appear in North American and European references (Breitenbach and Kränzlin 1983, Dennis 1978, Pomerleau 1980, Seaver 1928, Smith, Smith and Weber 1981) which are in current use, are listed for each species. A key to the species of *Helvella* in Alberta is provided.

Based primarily on discontinuities associated with stipe and apothecium structure, Dissing (1966) disposed the species of *Helvella* among seven sections: *Leucomelaenae, Acetabulum, Macropodes, Crispae* (= *Helvella*), *Lacunosae, Ephippium,* and *Elasticae.* These sections may have phylogenetic implications, but for now we regard them as useful taxonomic subdivisions which facilitate identification within the genus. All of these sections are represented in Alberta. We have indicated the section in which each species described below is found. Further, and in keeping with Dissing's system, we have described an eighth section, '*Silvicolae*', to accommodate *H. silvicola*, a species not considered by Dissing in 1966.

Materials and Methods

Collections of fresh and dried material from Alberta were examined. Tissue from dried specimens was rehydrated in 10% KOH. Microscopic details were examined using free-hand sections and squash preparations mounted in lactophenol cotton blue. Distilled water mounts were used for ascospore measurements. Habit drawings were prepared to represent ascocarps in the fresh condition and were based on dried specimens and photographs where possible. Fresh specimens were air dried and deposited in the University of Alberta Cryptogamic Herbarium (ALTA). All collections examined are deposited in ALTA or the National Mycological Herbarium, Ottawa (DAOM).

Key to the species of *Helvella* in Alberta

1. Apothecium arising vertically from a short stalk, splitting to form a single erect auriculoid lobe .... *H. silvicola*

1'. Apothecium cupulate, plane or reflexed, saddle-shaped, convex, or irregularly lobed; if split at maturity not forming an auriculoid lobe 2

2. Apothecium more or less cupulate to plane or reflexed at maturity 3

2'. Apothecium saddle-shaped, strongly convex, or irregularly lobed and wrinkled at maturity 11

3. Stipe distinctly ribbed; ribs on the underside of the apothecium extending from the base to the marginal region 4

3'. Stipe lacking ribs, or if present, never extending beyond the stipe apex 5

4. Hymenium medium brown; margin of apothecium often reflexed over stipe at maturity; stipe robust; ascospores 15-18 x 11-13 um .... *H. robusta*

4'. Hymenium dark brown; margin of apothecium regular or wavy but never reflexed over the stipe; stipe indistinct or prominent but never robust; ascospores 16-20 x 11-14 um .... *H. acetabulum*

5. Ascospores subfusiform and triguttulate; stipe length less than half the diam of the apothecium .... *H. brevis*

5'. Ascospores broadly ellipsoidal and uniguttulate, stipe length variable 6

6. Stipe prominent and distinct from apothecium 7

6'. Stipe not prominent, typically short and expanding into the apothecium or virtually absent 10

7. Ascocarp black or nearly so 8

7'. Ascocarp brown or grey; stipe typically paler than hymenium 9

8. Ascospores 17-20 x 10.5-13 um; stipe length less than or equal to the diam of the apothecium; terrestrial .... *H. corium*

8'. Ascospores 22-32 x 11-17 um; stipe length at least twice the diam of the apothecium; lignicolous .... *Plectania nannfeldtii*

See discussion under *H. corium*.

9. Stipe often ribbed; stipe pubescent; apothecium typically brown .... *H. solitaria*

9'. Stipe terete; stipe villose or rarely pubescent; apothecium typically grey .... *H. villosa*

10 Ascocarp stipitate; stipe distinctly ribbed .... *H. confusa*

10'. Ascocarp substipitate to sessile; stipe base may be folded, wrinkled or fluted but not distinctly ribbed .... *H. leucomelaena*

11. Stipe strongly ribbed; internally chambered 12

11'. Stipe terete; solid or hollow 14

12. Ascocarp grey to almost black; excipular surface glabrous .... *H. lacunosa*

12'. Ascocarp creamy white to brown; excipular surface pubescent 13

13. Hymenium creamy white to pale beige; ascospores 17-20 x 10-13 um .... *H. crispa*

13'. Hymenium medium to dark brown; ascospores 18-22 x 11-14 um .... *H. maculata*

14. Stipe dark grey to black, often paler at base; excipular surface glabrous.. *H. atra*

14'. Stipe white to grey brown; excipular surface glabrous to villose 15

15. Stipe and excipular surface villose 16

15'. Stipe and excipular surface glabrous .... *H. elastica*

16. Hymenium dark brown to black .... *H. pezizoides*

16'. Hymenium pale grey to grey brown .... *H. ephippium*

Helvella acetabulum (L. : Fr) Quél., Ench. Fung. 275. 1886. Figs. 1-4. Section *Acetabulum* Dissing. Basionym: *Peziza acetabulum* L., Sp. Pl. 2:1181. 1753. Synonyms: *Paxina acetabulum* (L. : Fr.) O. Kuntze, fide Dissing, 1966. *Paxina barlae* (Boud.) Seaver, fide Dissing, 1966. *Paxina sulcata* (Pers.) O. Kuntze, fide Dissing, 1966.

Apothecium: initially deeply cupulate, expanding with age and developing a wavy, irregular margin, 1-8 cm diam, hymenium dark brown, excipular surface yellow brown to whitish, paling toward the stipe, pubescent, conspicuously ribbed. **Stipe:** roughly equal, pubescent, deeply fluted, internally chambered, white to yellowish, the prominent ribs continuous with those on the outer surface of the apothecium, 10-40 x 5-30 mm. **Asci:** hyaline, cylindrical, tapering slightly to base, up to 330 x 17 um. **Paraphyses:** hyaline, almost equal or enlarged to 4-6 *u*m diam at apex. **Ascospores:** hyaline, broadly ellipsoidal, 16-20 x 11-14 *u*m. **Habitat:** on the ground in woods under *Populus* or *Picea*. **Collections examined:** ALTA 626, L. L. Kennedy, June 30 1964, west of Millet. ALTA 7958, R. S. Currah, June 25, 1979, U. of A. Devonian Botanic Garden, Edmonton. ALTA 8264, S. Abbott, July 28, 1979, 10 km south of Leduc. ALTA 8293, R. M. Danielson, July 1, 1976, Bow Valley Provincial Park, near Seebe. DAOM 177719, K. Egger, August 7, 1980, upper falls, Bertha Lake Trail, Waterton National Park.

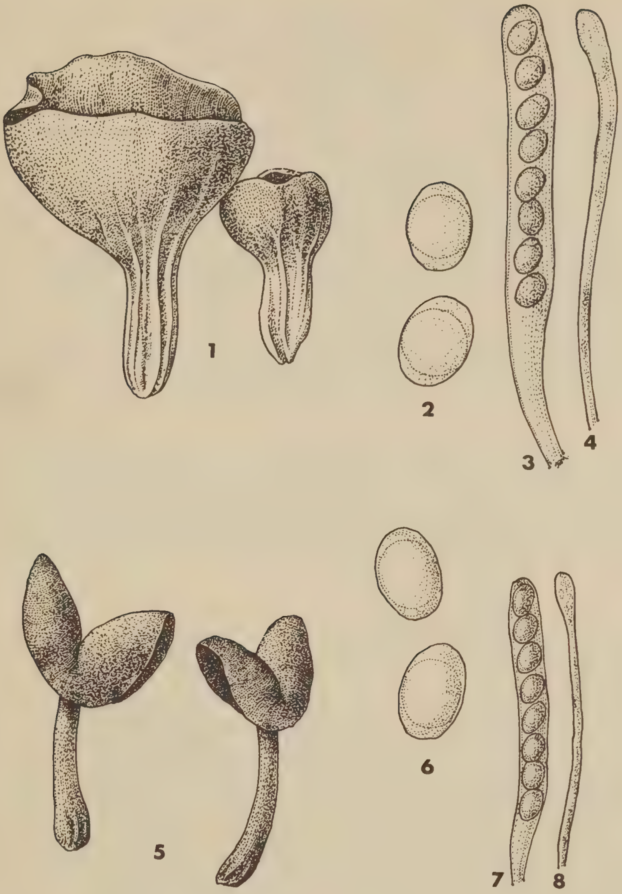
Notes: Harmaja (1977b) describes several species closely related to and previously included in *H. acetabulum*. Three collections (ALTA 626, 7958 and 8293) clearly represent *H. acetabulum* sensu Harmaja. Another collection (ALTA 8264) consisting of a single specimen resembles *H. arctoalpina* Harmaja in some respects but it is not possible to apply this name with confidence. The spore size of this specimen ranges from 17-20 x 10-13 *u*m. This size range matches the typical dimensions of the spores of *H. arctoalpina*, but it is also within the range of variation exhibited by *H. acetabulum* sensu Harmaja. Until more Alberta specimens are collected, and clearer distinctions can be made between *H. acetabulum* and *H. arctoalpina*, Dissing's broader concept of *H. acetabulum* will be used. *H. acetabulum* has been reported from Alberta by Larsen and Denison (1978).

Helvella atra Holmskj. : Fr., Syst. Myc. 2:19. 1823. Figs. 5-8. Section *Ephippium* Dissing. Basionym: *Helvella atra* Holmskj., Beata ruris otia Fungis Danicis impensa 2:47, Tab. 25. 1799. Synonyms: *Leptopodia atra* (Holmskj. : Fr.) Boud., fide Dissing, 1966.

Apothecium: irregularly lobed to saddle-shaped, often laterally compressed, 0.5-3 cm diam, hymenium dark grey to black, excipular surface grey, glabrous. **Stipe:** terete, solid, usually fluted, especially near the enlarged basal region, pubescent, dark grey, white over the extreme basal portion and often yellow or yellowish grey above, 20-50 x 3-8 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 225 x 17 *u*m. **Paraphyses:** brown to pale brown, enlarged to 9 *u*m diam at apex. **Ascospores:** hyaline, broadly ellipsoidal, 15-19.5 x 10-12.5 *u*m. **Habitat:** scattered on ground near *Salix*, or on rotting deciduous wood. **Collections examined:** ALTA 8265, S. Abbott, August 10, 1983, Minnie Lake near Glendon. ALTA 8266, S. Abbott, July 25, 1987, Devonian Botanic Garden, Edmonton. ALTA 8297, S. Abbott, July 28, 1987, Devonian Botanic Garden, Edmonton.

Notes: *H. atra* resembles *H. pezizoides* (q.v.) but the two can be differentiated because *H. pezizoides* has a paler, villose excipular surface and paler stipe. The excipular surface of *H. atra* is smooth.

Weber (1972) recognizes a very closely related species, *H. subglabra* Weber, and notes that *H. subglabra* "frequently has individual cells and hyphae projecting on the sterile surface of the apothecium when young," while *H. atra* is glabrous throughout its development. In *H. atra*, the walls of the outer excipulum are brown, while those of the medullary excipulum are typically hyaline, although a few walls may be brown (Dissing 1966). *H. subglabra* has few brown walled cells in the ectal excipulum and many hyphae with brown walls in the medullary excipulum (Weber 1972). *H. subglabra* is also separated from *H. atra* by having dark grey, rather than black fruiting bodies. Problems in identification arise in the examination of herbarium material because fruiting bodies of *H. subglabra* may turn black when dried. Weber (1972) admits that mature fruiting bodies of *H. subglabra* may be glabrous and this feature is therefore of limited usefulness except when large collections with a complete range of developmental stages are available. Size ranges for all anatomical features of *H. subglabra* are comparable to those given for *H. atra* (Dissing 1966). Correlation of a greater number of characteristics is needed before *H. subglabra* can be accepted as a species distinct from *H. atra*.



Figs. 1-8. Figs. 1-4. *Helvella acetabulum* (ALTA 7958). Fig. 1. Cupulate apothecia with conspicuously ribbed stipe and excipular surface. X 0.7. Fig. 2. Ascospores. X 650. Fig. 3. Ascus. X 360. Fig. 4. Paraphysis. X 720. Figs. 5-8. *Helvella atra* (ALTA 8297). Fig. 5. Dark, saddle-shaped, laterally compressed apothecia. with terete stipe. X 0.7. Fig. 6. Ascospores. X 720. Fig. 7. Ascus. X 250. Fig. 8. Paraphysis. X 280.

Kempton and Wells (1970) also report *H. atra* on rotting deciduous wood.

Helvella brevis (Peck) Harmaja, Karstenia 14:104. 1974. Figs 9-12. Section *Macropodes* Dissing. Basionym: *Helvella macropus* (Pers. : Fr.) Karst. var. *brevis* Peck, Bull. Torrey Bot. Club 29:74. 1902. Synonyms: ?*Paxina subclavipes* (Phill. and Ellis) Seaver, North Am. Cup Fung. (Operc.):206. 1928.

Apothecium: cupulate, margin entire or irregularly split, 25 mm diam, hymenium brown, excipular surface slightly paler, pubescent. **Stipe:** terete, solid, equal, concolorous with the excipular surface, pubescent, 6-7 x 1.5-2 mm, typically buried in the substrate. **Asci:** hyaline, cylindrical, tapering to base, up to 175 x 17 *u*m. **Paraphyses:** hyaline, enlarged to 7 *u*m at apex. **Ascospores:** hyaline, subfusiform, verruculose, triguttulate with a large central oil drop and a smaller one at each end, rarely uniguttulate, 18-23.5 x 10.5-12 *u*m. **Habitat:** gregarious on sandy soil under mixed *Betula*, *Alnus* and *Picea*. **Collections examined:** ALTA 8294, R. M. Danielson, July 31, 1974, Fort McMurray.

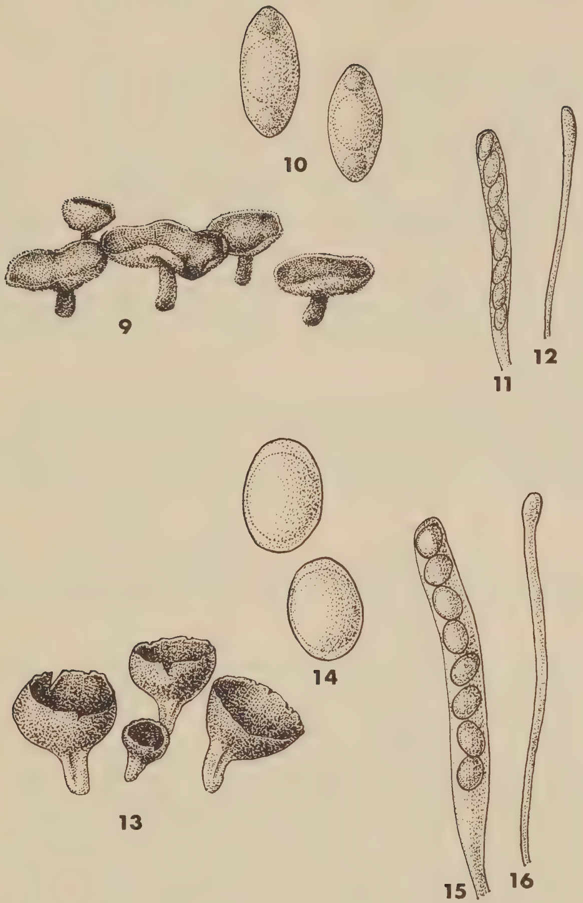
Notes: *H. brevis* can be distinguished from other species in the genus by its subfusiform, usually triguttulate ascospores. *H. brevis* is distinguished from *H. macropus* (Pers. : Fr.) Karst. (see Weber 1972) on the basis of its short stipe and smaller ascospores. The stipe of *H. macropus* may be up to 7 cm long and the ascospores are typically 21-24 x 10.5-12.5 *u*m.

Seaver (1928) lists *Helvella macropus brevis* as a synonym for *Paxina subclavipes* (Phill. and Ellis) Seaver. Seaver's description resembles our collection of *H. brevis* in morphology, but the ascospores of *P. subclavipes* are described as ellipsoidal and are slightly narrower than our collection. Examination of the type material is necessary to determine whether the two are conspecific. If this is the case, then the epithet *subclavipes* (1887) would have priority.

Helvella confusa Harmaja, Karstenia 17:40. 1977. Figs. 13-16. Section *Leucomelaena* Dissing. Synonyms: *Helvella solitaria* (Karst.) Karst., sensu Dissing, 1966, fide Harmaja, 1977a.

Apothecium: deeply cupulate, expanding and becoming shallowly concave with age, 8-28 mm diam and up to 12 mm deep, hymenium dark grey brown, excipular surface concolorous with the hymenium near the margin, becoming paler (smokey brown to white) near the stipe, pubescent. **Stipe:** short, expanding to apex, solid, slightly to deeply fluted, ribs few and well-separated, white, 3-10 x 2-8 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 300 x 18 *u*m. **Paraphyses:** brown, enlarged to 7 *u*m diam at apex. **Ascospores:** hyaline, broadly ellipsoidal, 18-22 x 12.5-15 *u*m. **Habitat:** clustered on mossy ground on banks of an alpine flood plain with *Abies* and *Pinus* nearby. **Collections examined:** ALTA 8274, R. S. Currah, August 29, 1987, Penstock Creek, Jasper National Park.

Notes: Dissing (1966) referred to material of this taxon as *H. solitaria* (Karst.) Karst. After reviewing the type material of *H. solitaria*, Harmaja (1977a) concluded that *H. solitaria* and *H. queletii* Bres. are conspecific. Karsten's *H. solitaria* has priority over *H. queletii* Bres. Thus, here, *H. solitaria* (q.v.) refers to *H. queletii* sensu Dissing, while *H. confusa* refers to *H. solitaria* sensu Dissing. *H. confusa* is most closely related to *H. leucomelaena* (q.v.).



Figs. 9-16. Figs. 9-12. *Helvella brevis* (ALTA 8294). Fig. 9. Small, shallowly cupulate apothecia with short pubescent stipe. X 0.7. Fig. 10. Ascospores. X 815. Fig. 11. Ascus. X 210. Fig. 12. Paraphysis. X 205. Figs. 13-16. *Helvella confusa* (ALTA 8274). Fig. 13. Small, cupulate apothecia with short, ribbed stipe. X 0.7. Fig. 14. Ascospores. X 720. Fig. 15. Ascus. X 280. Fig. 16. Paraphysis. X 360.

Helvella corium (Weberb.) Massee, Brit. Fung. Fl. 4:463. 1895. Figs. 17-20. Section *Macropodes* Dissing. Basionym: *Peziza corium* Weberb., Pilze Norddeutschl. 1:7, Tab. 3, Fig. 7a-d. 1873. Synonyms: *Cyathipodia corium* (Weberb.) Gill., fide Dissing, 1966. *Paxina corium* (Weberb.) Seaver, North Am. Cup Fung. (Operc.):208. 1928.

Apothecium: initially cupulate with an inrolled margin, expanded at maturity, 9-25 mm diam, margin wavy, irregular, hymenium black, excipular surface dark brown to black, pubescent, margin often white, entire or serrate. **Stipe:** equal, terete to slightly fluted, solid, pubescent, dark brown to black, 5-10 x 1-3 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 225 x 17 *u*m. **Paraphyses:** brown, enlarged to 7 *u*m diam at apex. **Ascospores:** hyaline, ellipsoidal, 17-20 x 10.5-13(15) *u*m. **Habitat:** gregarious on bare wet ground, associated with *Salix* and *Populus*. **Collections examined:** ALTA 8267, R.S. Currah, August 20, 1985, Devonian Botanic Garden, Edmonton. ALTA 8296, R. M. Danielson, August 10, 1975, near Banff townsite, Banff National Park.

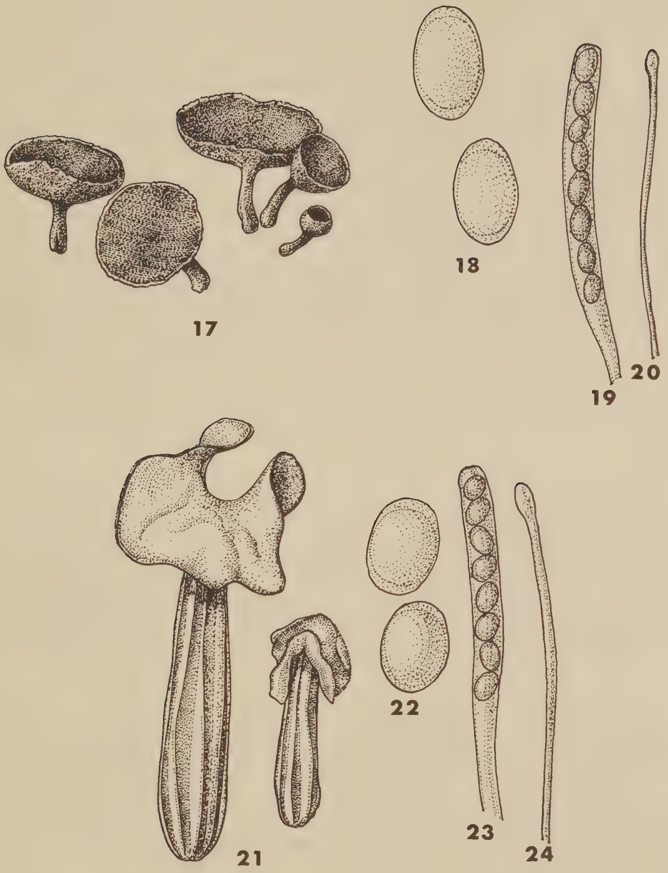
Notes: One of our collections (ALTA 8296) is unusual in having broader ascospores (13-15 *u*m) than what is generally considered normal for this species. The specimens fit the description of *H. corium* in all other respects. This species has been reported from Alberta by Larsen and Denison (1978).

A single collection (ALTA 627) of a superficially similar ascomycete, *Plectania nannfeldtii* Korf (=*Paxina nigrella* Seaver, (Paden, Pers. Comm.)), was also examined. It can be differentiated from *H. corium* by its larger, narrowly ellipsoidal ascospores each of which typically possesses two small oil droplets, and by its lignicolous growth habit. The size, shape and guttulae of the ascospores of *Plectania nannfeldtii* exclude this species from the genus *Helvella*.

Helvella crispa Scop. : Fr., Syst. Myc. 2:14. 1823. Figs. 21-24. Section *Helvella* Dissing (= section *Crispae*, Dissing 1966). Basionym: *Phallus crispus* Scop., Fl. Carnol. 2:475. 1772.

Apothecium: irregularly lobed and wrinkled, 1-5 cm diam, hymenium creamy white to beige, excipular surface beige, pubescent. **Stipe:** deeply fluted and ribbed, internally chambered, pubescent, white to whitish, 20-130 x 5-30 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 225 x 17 *u*m. **Paraphyses:** hyaline, swollen to 6-8 *u*m diam at apex. **Ascospores:** hyaline, broadly ellipsoidal, 17-20 x 10-13 *u*m. **Habitat:** scattered on the ground or solitary under *Corylus cornuta* or *Populus*. **Collections examined:** ALTA 661, E. Bozniak and J. Wheelock, September 14, 1965, Muir Lake area. ALTA 662, J. States, August 13, 1967, Long Lake. ALTA 663, M. Dumais, July 27, 1968, McKay River south of Fort McMurray. ALTA 7292, L. L. Kennedy, September 15, 1976, Forest Reserve, Edmonton. ALTA 7934, R. Currah, September 4, 1977, Devonian Botanic Garden, Edmonton. ALTA 7901, H. Schalkwyk, September 5, 1978, east of Redwater. ALTA 7957, R. S. Currah, July 1979, Devonian Botanic Garden, Edmonton. ALTA 8268, M. Van Dyk, August 31, 1980, Devonian Botanic Garden, Edmonton. ALTA 8275, R. S. Currah, July 21, 1982, Devonian Botanic Garden, Edmonton. ALTA 8276, S. Abbott, September 3, 1987, Devonian Botanic Garden, Edmonton. ALTA 8283, S. Abbott, August 8, 1981, 10 km south of Leduc.

Notes: This species is the type of Dissing's section *Helvella*. *Helvella crispa* is the most frequently collected species of *Helvella* in at least the central region of Alberta. Dissing (1966) suggests that this species may have a northern limit at 60-62° N. Larsen and Denison (1978) report *H. crispa* from Alberta.



Figs. 17-24. Figs. 17-20 *Helvella corium* (ALTA 8267). Fig. 17. Dark cupulate or plane apothecia with short stipe. X 0.9. Fig. 18. Ascospores. X 790. Fig. 19. Ascus. X 235. Fig. 20. Paraphysis. X 260. Figs. 21-24. *Helvella. crispa* (ALTA 7534). Fig. 21. Irregularly lobed apothecia with distinctly ribbed stipe. X 0.7. Fig. 22. Ascospores. X 650. Fig. 23. Ascus. X 255. Fig. 24. Paraphysis. X 315.

Helvella elastica Bull. : Fr., Syst. Myc. 2:21. 1823. Figs. 25-28. Section *Elasticae* Dissing. Basionym: *Helvella elastica* Bull., Herb. France Pl. 242, Figs. A, B, D-G. 1785. Synonyms: *Leptopodia elastica* (Bull. : Fr.) Boud., fide Dissing, 1966.

Apothecium: roughly convex, irregularly lobed, to saddle-shaped, 5-40 mm diam, hymenium dark brown to brown, excipular surface whitish to yellowish, glabrous. **Stipe:** terete, hollow, slightly enlarged at base, often slightly fluted, glabrous, white to yellowish, especially when dried, 10-100 x 2-10 mm. **Asci:** hyaline, cylindrical, tapering gradually to base, up to 280 x 19 *u*m. **Paraphyses:** hyaline, enlarged to 5-7 *u*m at apex. **Ascospores:** hyaline, broadly ellipsoidal, 18-22 x 11-15 *u*m. **Habitat:** on the ground with moss, under *Picea* or *Larix*. **Collections examined:** ALTA 667, A. Stewart, August 16, 1962, near Ponoka. ALTA 8269, S. Abbott, July 27, 1987, Devonian Botanic Garden, Edmonton. ALTA 8270, R. S. Currah, August 19, 1980, Devonian Botanic Garden, Edmonton. DAOM 179970, H. Schalkwyk, August 16, 1980, Sandy Lake.

Notes: The closely related *H. albella* Quél. has been reported from Alaska (Kempton and Wells, 1970) and Colorado (Larsen and Denison 1978), as well as from Europe (Dissing 1966) but no collections are known from Alberta. Weber (1972) reports that the spores of *H. albella* are slightly larger than those of *H. elastica* but this difference was not reported by Dissing for European specimens. It is possible that the two names are synonymous since the literature (Dissing 1966, Weber 1972) indicates considerable overlap in distinguishing features (time of fruiting, colour and degree of involution of the apothecial margin).

Helvella ephippium Lév., Ann. Sci. Nat. Ser. 2, 16:240. 1841. Figs. 29-32. Section *Ephippium* Dissing. Synonyms: *Leptopodia ephippium* (Lev.) Boud., fide Dissing, 1966.

Apothecium: roughly saddle-shaped or irregularly lobed, margin inrolled over hymenium initially, expanding at maturity, 5-15 mm diam, hymenium grey brown to brown, excipular surface lighter grey brown to tan, villose. **Stipe:** terete, solid, pale grey brown, villose, 15-20 x 1.5-3 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 250 x 17 *u*m. **Paraphyses:** hyaline, gradually enlarged to 3-7 *u*m diam at apex. **Ascospores:** hyaline, broadly ellipsoidal, 17-21 x 11-13 *u*m. **Habitat:** solitary on moist soil under *Populus* and *Corylus*. **Collections examined:** ALTA 7446, I. Tsuneda, Septmeber 15, 1976, Emily Murphy Park, Edmonton. ALTA 8287, R. M. Danielson, September 14, 1973, Pearce Estate, Calgary.

Notes: Although superficially similar to other species in the section, *H. ephippium* can be distinguished by the grey to grey brown hymenium and the consistently villose excipular surface and stipe. *H. pezizoides* (q.v.) is distinguished from *H. ephippium* by its dark grey to black hymenium. *H. stevensii* Peck has a paler hymenium and very fine pubescence on the excipular surface. Dissing and Lange (1967) provide a key and a detailed discussion of the taxonomy of *H. ephippium*, *H. pezizoides*, *H. connivens* and *H. stevensii*. *H. ephippium* has been reported from Alberta (Larsen and Denison 1978).

Helvella lacunosa Afz. : Fr., Syst. Myc. 2:15. 1823. Figs. 33-36. Section *Lacunosae* Dissing. Basionym: *Helvella lacunosa* Afz., Kgl. Vet.-Akad. nya Handl. 4:303. 1783. Synonyms: *Helvella mitra* L. sensu Seaver, fide Dissing, 1966. *Helvella sulcata* Afz., fide Dissing, 1966.

Apothecium: very irregularly lobed and wrinkled or irregularly saddle-shaped, often fused at margin to stipe, 1-7 cm diam, hymenium light to dark grey, excipular surface light grey, sparingly veined or ribbed, glabrous. **Stipe:** deeply fluted and ribbed, lacunose, internally chambered, smokey grey brown to whitish in parts, 20-80 x 6-30 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 260 x 17 *u*m. **Paraphyses:** brown, contents granular, swollen to 10 *u*m at apex. **Ascospores:** hyaline, broadly ellipsoidal, usually containing one large oil drop which may fill the entire spore, 14.5-20 x 10-13 *u*m. **Habitat:** on the ground in sandy soil near *Populus* and *Pinus*. **Collections examined:** ALTA 7291, L. L. Kennedy, September 15, 1976, Forest Reserve, Edmonton. ALTA 8271, S. Abbott, August 24, 1987, Devonian Botanic Garden, Edmonton. DAOM 179971, H. Schalkwyk, August 27, 1980, near Devon.

Notes: Dissing (1966) concludes that *H. sulcata* is conspecific with *H. lacunosa*, although Weber (1972) treats *H. sulcata* as a distinct species. Weber's (1972) concept of *H. sulcata* included a saddle-shaped apothecium lacking ribs on the sterile surface, preference for upland habitats, and spores 14-18 x 10.5-12.5 *u*m. Weber's *H. lacunosa* is characterized by a mitrate apothecium, ribbed sterile surface, and ascospores of 16.5-22 X 10.5-14 *u*m. The ascospores of our material measures 14.5-17 X 10-13 *u*m (ALTA 7291), 14.5-19 X 10-12 *u*m (ALTA 8271), and 15-20 X 10-13 *u*m (DAOM 179971), overlapping the typical ranges of both *H. sulcata* and *H. lacunosa* sensu Weber. All collections are from well drained sites and possess sparse ribbing on the excipular surface. Both mitrate and saddle-shaped specimens have been collected. Because of the degree of overlap among these characters, it would appear to us that *H. sulcata* and *H. lacunosa* are synonyms.

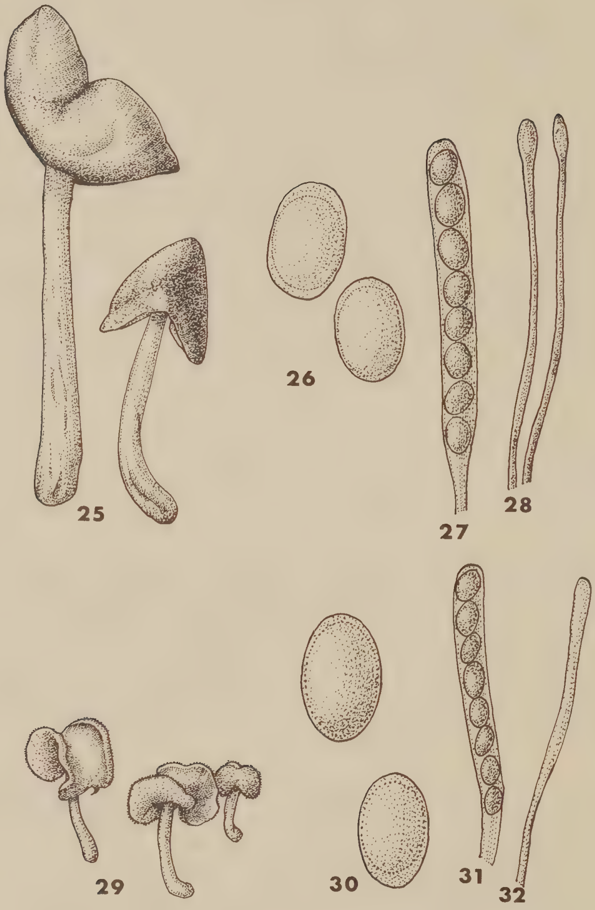
Helvella leucomelaena (Pers.) Nannf., in Lundell and Nannfeldt, Fungi. Exsic. Suec. Praes. Upsal. Fasc. 19-20:21. 1941. Figs. 37-40. Section *Leucomelaenae* Dissing. Basionym: *Peziza leucomelas* Pers., Mycol. Eur. 1:219. 1822. Synonyms: *Paxina leucomelas* (Pers.) O. Kuntze, fide Dissing, 1966.

Apothecium: deeply cupulate, expanding in age, 4-6 cm diam, hymenium brown to dark brown, excipular surface brown to dark brown, pubescent. **Stipe:** short, often indistinct, sparingly fluted, white, pubescent, 4-9 x 3-7 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 300 x 20 *u*m. **Paraphyses:** hyaline, enlarged to 7-9 *u*m at apex. **Ascospores:** hyaline, ellipsoidal, 20-24 x 11.5-15 *u*m. **Habitat:** solitary on moist ground under *Picea* or *Abies*. **Collections examined:** ALTA 8290, R. M. Danielson, August 13, 1972, Marmot Creek Basin near Seebe. DAOM 56885, J. W. Groves and R. J. Bourchier, July 12, 1957, Kananaskis Forest Experimental Station. DAOM 177741, K. Egger, August 11, 1980, Summit Lake Trail, Waterton National Park.

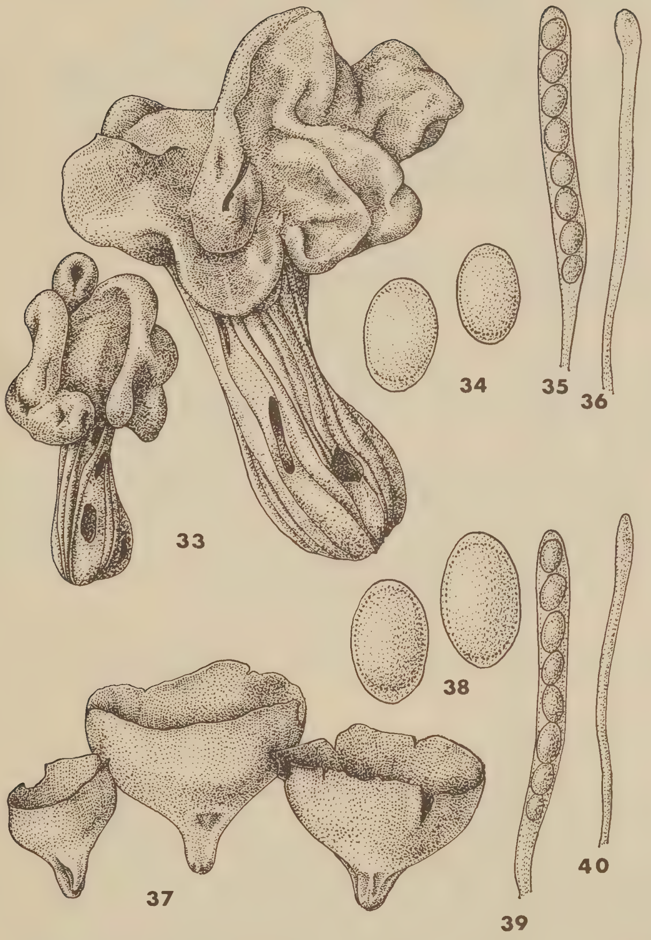
Notes: *Helvella leucomelaena* is most closely related to *H. confusa* (q.v.). *H. confusa* has a slender stipe which is distinct from the rather small apothecium. In *H. leucomelaena* the stipe merges gradually with the apothecium. The ascospores of *H. leucomelaena* are also slightly longer than those of *H. confusa*. According to Dissing (1966) and Kempton and Wells (1970), the apothecium of *H. leucomelaena* develops initially beneath the ground, as in *Sepultaria*, whereas *H. confusa* develops above the ground. *H. leucomelaena* has been reported from Alberta by Larsen and Denison (1978).

Helvella maculata Weber, Beih. Nova Hedwigia 51:27. 1975. Figs. 41-44. Section *Helvella* Dissing.

Apothecium: irregularly lobed and wrinkled to ± sadddle-shaped, margin inrolled over hymenium when young, margin expanding and often splitting with age, hymenium medium to dark brown or grey brown, excipular surface white, pubescent. **Stipe:** deeply fluted and ribbed, internally chambered, uniformly white, occasionally with pale grey brown stains, pubescent, typically enlarged at base, 2-6 x 0.5-3 cm. **Asci:** hyaline, cylindrical, tapering to base, up to 300 x 19 *u*m. **Paraphyses:** pale brown, enlarged to 6-9 *u*m at apex.



Figs. 25-32. Figs. 25-28. *Helvella elastica* (composite illustration, small right specimen is ALTA 8269). Fig. 25. Convex or saddle-shaped apothecia with terete stipe. X 0.7. Fig. 26. Ascospores. X 720. Fig. 27. Ascus. X 265. Fig. 28. Paraphyses. X 360. Figs. 29-32. *Helvella ephippium* (ALTA 8287). Fig. 29. Small irregularly saddle-shaped apothecia, with villose excipular surface and terete stipe. X 1.1. Fig. 30. Ascospores. X 825. Fig. 31. Ascus. X 255. Fig. 32. Paraphysis. X 330.



Figs. 33-40. Figs. 33-36. *Helvella lacunosa* (ALTA 8271). Fig. 33. Large, dark irregularly lobed apothecia with dark, lacunose stipe. X 0.7. Fig. 34. Ascospores. X 790. Fig. 35. Ascus. X 255. Fig. 36. Paraphysis. X 325. Figs. 37-40. *Helvella leucomelaena* (ALTA 8290). Fig. 37. Cupulate apothecia with indistinct, flaring stipe. X 0.7. Fig. 38. Ascospores. X 815. Fig. 39. Ascus. X 215. Fig. 40. Paraphysis. X 240.

Ascospores: hyaline, broadly ellipsoidal, 18-22 x 11-14 *u*m. **Habitat:** solitary on the ground in *Picea* or mixed *Picea* woods. **Collections examined:** ALTA 8292, R. M. Danielson, September 18, 1976, Bragg Creek. DAOM 143866, R. M. Danielson, July 29, 1972, Brown-Lowery Park, Calgary. DAOM 143867, R. M. Danielson, August 20, 1972, Fish Creek, Calgary.

Notes: *H. maculata* is easily separated from *H. crispa* by its brown to grey brown hymenium and slightly larger ascospores. *H. lacunosa* lacks the brown hymenial pigmentation, possesses a darkly pigmented stipe and does not develop with the apothecial margin reflexed over the hymenium initially. Our collections of this species do not show the mottled hymenium observed by Weber (1975). Weber states that the ascospore size for the species ranges from 20-23 x 12-13.5 *u*m. The ascospores of the Alberta collections are slightly smaller. The occurrence of *H. maculata* in Alberta has been reported by Larsen and Denison (1978).

The superficially similar *Pseudorhizina sphaerospora* Peck (Pouz.), also known from Alberta (ALTA 7158, 8263) can be distinguished by its indistinct outer excipulum, spherical ascospores and lignicolous growth habit.

Helvella pezizoides Afz. : Fr., Syst. Myc. 2:20. 1822. Figs. 45-48. Section *Ephippium* Dissing. Basionym: *Helvella pezizoides* Afz., Kgl. Vet.-Akad. nya Handl. 4:308, Pl. 10, Fig. 2. 1783. Synonyms: *Leptopodia pezizoides* (Afz. : Fr.) Boud., fide Dissing, 1966.

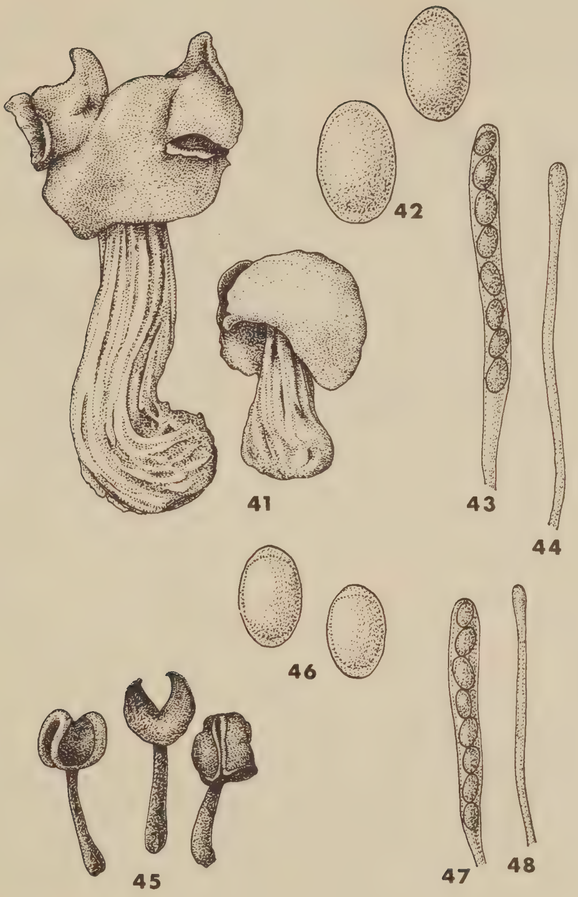
Apothecium: irregularly lobed to saddle-shaped, 8 mm diam, hymenium black, excipular surface grey brown, villose. **Stipe:** terete, solid, villose, especially near apex, enlarged toward base, grey brown, 10 x 2 mm. **Asci:** hyaline, cylindrical, tapering to base, 200 x 15 *u*m. **Paraphyses:** light brown, enlarged to 4-6 *u*m at apex. **Ascospores:** hyaline, broadly ellipsoidal, 17-19 x 9-11 *u*m. **Habitat:** on the ground. **Collections examined:** ALTA 7606, W. Elisens, August 1977, Kinsmen Ravine, Edmonton.

Notes: *H. pezizoides* is closely related to *H. atra*, but can be distinguished by its excipular surface texture and ascocarp colouration (see discussions under *H. atra* and *H. ephippium*).

Helvella robusta Abbott, sp. nov. Figs. 49-58. Section *Acetabulum* Dissing.

Apothecium irregulariter cupulatum vel centraliter depressum cum marginibus reflectis, 5-9 cm diam, hymenium medie brunneum, excipulum candidum ad pallide brunneum, pubescens, distincte costatum, costae excipuli cum costis stipitis cuniunctae et ad partem marginalem extendentes. Excipulum ectale cum prominentibus brevibus materiam hyalinam continentibus et tunicis stramineo-coloratis, cellae terminales clavate ad sub-cylindricae, fere 25 x 12 um. *Stipes robustus, distincte costatus, gradualiter in apothecium extendens, candidius ad pallide brunneus, pubescens, 3-5 x 3-5 cm. Asci hyaline, cylindrici, ad basim angustati, 220-230 x 15-18* um. *Paraphyses fere hyalinae, accumulatae pallide, in apice clavatae, 4.5 - 7.5* um *in apice. Ascosporae hyaline, late ellipsoideae, uniguttulatae, leves, 15-18(19) x (10.5)11-13(14)* um. *Holotypus apothecium exsiccatum* DAOM 143869.

Apothecium: irregularly cupulate or centrally depressed with margins reflexed, 5-9 cm diam, hymenium medium brown, excipular surface white to pale brown, pubescent, markedly ribbed, ribs continuous with those of the stipe and extending to the marginal region. Ectal excipulum with short projecting elements with hyaline contents and straw-coloured walls, terminal cells clavate to subcylindrical, about 25 x 12 *u*m. **Stipe:**



Figs. 41-48. Figs. 41-44. *Helvella maculata* (Composite illustration, small specimen is DAOM 143866). Fig. 41. Irregularly lobed apothecia with distinctly ribbed stipe. X 0.7. Fig. 42. Ascospores. X 750. Fig. 43. Ascus. X 225. Fig. 44. Paraphysis. X 280. Figs. 45-48. *Helvella pezizoides* (ALTA 7606, specimen on left). Fig. 45. Small, dark, irregularly saddle-shaped apothecia with terete stipe. X 1.2. Fig. 46. Ascospores. X 720. Fig. 47. Ascus. X 275. Fig. 48. Paraphysis. X 300.

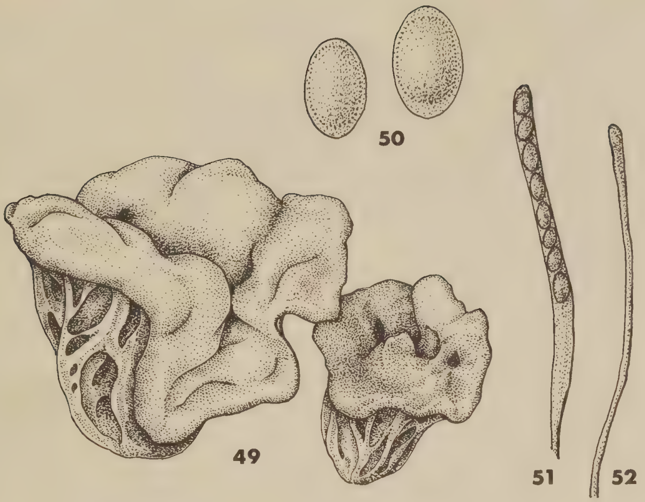
robust with prominent ribs, internally chambered, gradually expanding into the apothecium, white to pale brown, pubescent, 3-5 x 3-5 cm. **Asci:** hyaline, cylindrical, tapering to base, 220-230 x 15-18 *u*m. **Paraphyses:** ± hyaline, pale brown in mass, clavate , 4.5 -7.5 *u*m at apex. **Ascospores:** hyaline, broadly ellipsoidal, uniguttulate, smooth, 15-18(19) x (10.5)11-13(14) *u*m. **Habitat:** Solitary on the ground under *Populus balsamifera* or *Salix*. **Collections examined:** ALTA 8291, R. M. Danielson, September 11, 1972, Glenmore Park, Calgary. HOLOTYPE DAOM 143869, dried apothecium, R. M. Danielson, August 30, 1972, Nose Hill area, Calgary.

Notes: *H. robusta* resembles other species in the section *Acetabulum* (e.g. *H. costifera* Nannf., *H. hyperborea* Harmaja, *H. unicolor* (Boud.) Diss. and *H. acetabulum* (q.v.)) in having a more or less cupulate apothecium, prominent ribbing on the stipe with the ribs extending to the excipular surface, and in the pubescence found on both the stipe and excipular surface. *H. robusta* is unique because of its large size, broad stipe, and reflexed apothecial margin. Due to similar ascospore size and autumnal fruiting patterns, *H. robusta* appears most closely related to *H. costifera*, but the species differ with respect to colour, stipe size and shape, and in the size and shape of the paraphyses. *H. robusta* is medium brown, the stipe is nearly as broad as it is long, and the apices of the paraphyses are 4.5-7.5 *u*m diam. *H. costifera* has a much narrower stipe, pale grey to greyish brown hymenium and the paraphyses are only slightly enlarged (to 5 *u*m) at the apex. *H. hyperborea* has a dark grey brown hymenium, and a very slender stipe which is less prominently ribbed. The apothecium is regularly cupulate. *H. unicolor* (Boud.) Diss. is similar in colour to *H. robusta* but is smaller in stature and has larger ascospores (17-21 x 13-16 *u*m). *H. unicolor* fruits in the spring. *H. robusta* can be distinguished from *H. acetabulum* because *H. acetabulum*, like *H. unicolor*, fruits in the spring, and has a dark grey brown hymenium, and longer ascospores (17-20 *u*m). Both collections of *H. robusta* are from the southern region of Alberta and were found associated with members of the Salicaceae.

Helvella silvicola (Beck in Sacc.) Harmaja, Karstenia 14:103. 1974. Figs. 59-62. Section *Silvicolae* sect. nov. Basionym: *Otidea silvicola* Beck. in Sacc., Syll. Fung. 8:97. 1889. Synonyms: *Wynnella silvicola* (Beck in Sacc.) Nannf., fide Harmaja, 1974. *Wynnella auricula* (Cke.) Boud., in Pomerleau, 1980. *Otidea auricula* (Cke.) Massee, fide Harmaja, 1974. *Scodellina auricula* (Schaeff.) Seaver, fide Harmaja, 1974.

Apothecium: ear-shaped, split to form a strongly one-sided lobe, margin inrolled initially, expanding with age, typically erect, becoming somewhat laterally recurved in older specimens, 1-8 cm high, 0.5-5 cm across, hymenium dark red brown to brown, excipular surface concolourous or slightly paler, glabrous. **Stipe:** slightly wrinkled and folded or rarely shallowly fluted, indistinct, yellow brown, yellowish, or whitish near base, 2-9 x 2-5 mm. **Asci:** hyaline, cylindrical, tapering to base, 200 x 17-19 *u*m. **Paraphyses:** hyaline, contents granular, enlarged to 5-6 *u*m at apex. **Ascospores:** hyaline, broadly ellipsoidal, 19-24 x 14-17 *u*m. **Habitat:** solitary or numerous, on ground under *Picea* or *Larix*. **Collections examined:** ALTA 605, M. Ostafichuk, August 3, 1965, above Lake Louise, Jasper National Park. ALTA 7341, C. Strand, July 8, 1975, Winfield. ALTA 8272, S. Abbott, July 16, 1987, Fish Lake near Nordegg. ALTA 8273, S. Abbott, July 27, 48 km west of entering Rocky Clearwater Forest on Hwy 11. ALTA 8277, R. S. Currah, July 15, 1983, Highwood Pass. ALTA 8278, R. S. Currah, July 23, 1983, Devonian Botanic Garden, Edmonton. ALTA 8284, S. Abbott, July 6, 1980, Raven Fish Hatchery near Caroline.

Notes: Although unusual in many respects, this species clearly belongs in the genus *Helvella*. The microscopic characteristics of both the outer excipulum and the ascospores of *H. silvicola* are similar in all respects to those of the other species of *Helvella*. However, this species, only recently considered a member of the genus *Helvella* (Harmaja 1974), exhibits a



Figs. 49-52. *Helvella robusta* sp. nov. (left specimen is DAOM 143869, holotype, right specimen is ALTA 8291). Fig. 49. Large, irregularly cupulate apothecia with reflexed margins, and robust, distinctly ribbed stipe. X 0.5. Fig. 50. Ascospores. X 880. Fig. 51. Ascus. X 190. Fig. 52. Paraphysis. X 400.

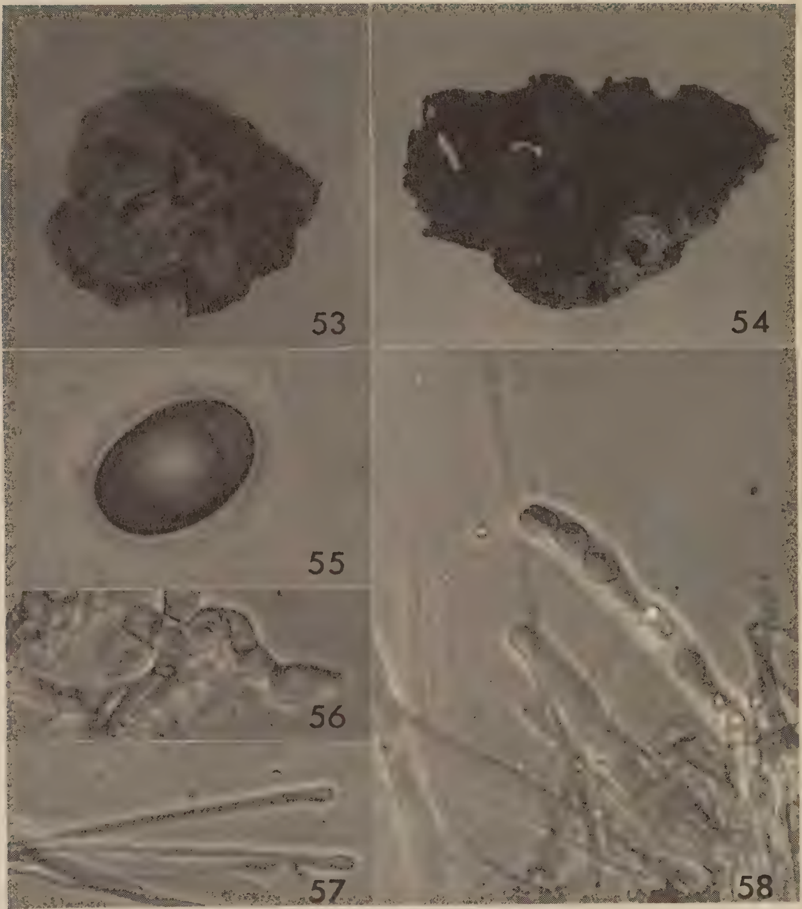
number of unique traits. Most notable is the elongated, one-sided apothecium. Although this growth habit is unique in the genus, some specimens of *H. leucomelaena* have been observed to have a similar lopsided, lobed form (Harmaja 1974). The distinctive colouration of the apothecium and stipe is similar to that seen in *H. acetabulum*, especially when dried material is compared. *Helvella aestivalis* (Heim and Remy) Dissing and Raitviir also exhibits a red brown apothecium colouration (Dissing 1983). The short stipe of *H. silvicola* typically is folded or shallowly fluted, reminiscent of some collections of *H. leucomelaena*. This species has been reported from Alberta by Larsen and Denison (1978) (as *Wynnella silvicola*).

Because of the unique auriculoid structure of the apothecium a new section, *Silvicolae*, is proposed to accommodate the species.

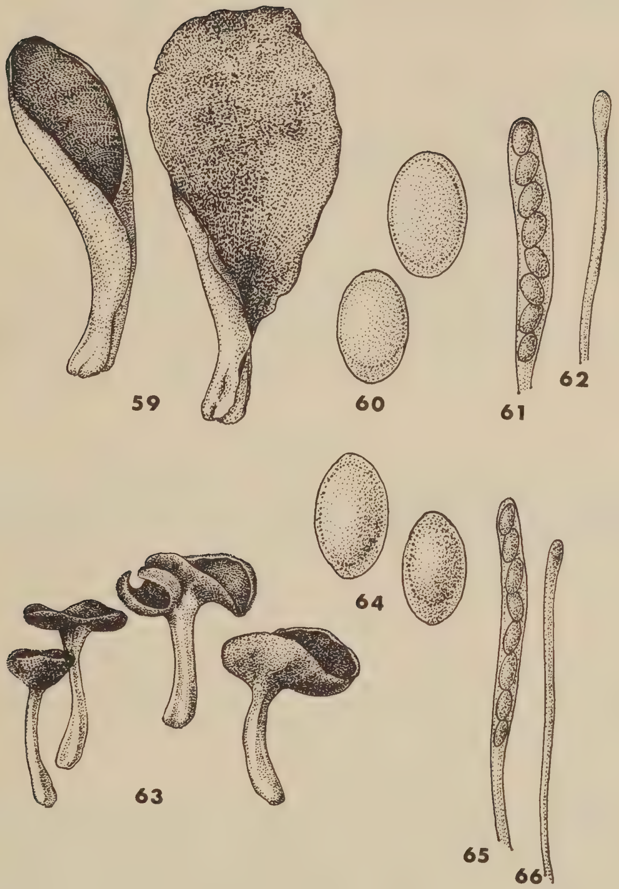
Sectio *Silvicolae* Abbott sect. nov.

Apothecium auriculatum ferrugineum, excipulum glabrum, stipes indistinctus et leviter costatus, ascosporae late ellipsoideae, uniguttulatae.

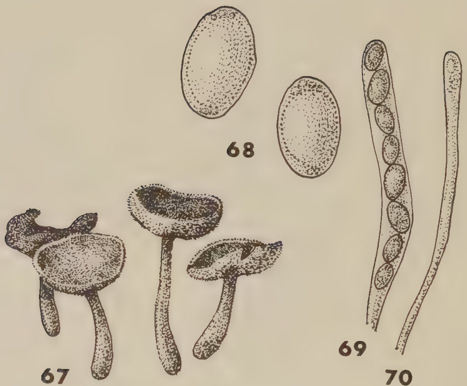
Apothecium auriculoid, reddish brown, excipular surface glabrous, stipe indistinct, shallowly fluted, ascospores broadly ellipsoidal, uniguttulate.



Figs. 53-58. *Helvella robusta* sp. nov. Fig. 53. (DAOM 143869). Ascocarp showing stipe and apothecium. X 0.6. Fig. 54. (ALTA 8291). Oblique view of irregularly cupulate apothecium. X 0.7. Fig. 55-58. Mounts from DAOM 14486. Fig. 55. Broadly ellipsoidal, uniguttulate smooth-walled ascospore. X 1440. Fig. 56. Hair from ectal excipulum. X 840. Fig. 57. Apical region of paraphyses. X 360. Fig. 58. Asci, paraphyses and uniseriate ascospores. X 360.



Figs. 59-66. Figs. 59-62. *Helvella silvicola* (right specimen is ALTA 8272, left specimen is ALTA 8273). Fig. 59. Erect, auriculoid apothecia with indistinct stipe. X 0.7. Fig. 60. Ascospores. X 720. Fig. 61. Ascus. X 265. Fig. 62. Paraphysis. X 420. Figs. 63-66. *Helvella solitaria* (ALTA 8295). Fig. 63. Irregularly cupulate apothecia with sparingly fluted stipe. X 0.7. Fig. 64. Ascospores. X 845. Fig. 65. Ascus. X 200. Fig. 66. Paraphysis. X 205.



Figs. 67-70. *Helvella villosa* (ALTA 8289). Fig. 67. Small, shallowly cupulate apothecium with villose stipe and excipular surface. X 1.4. Fig. 68. Ascospores. X 790. Fig. 69. Ascus. X 220. Fig. 70. Paraphysis. X 340.

Helvella solitaria (Karst.) Karst., Bidr. Kann. Finl. Nat. Folk 19:37. 1891. Figs. 63-66. Section *Macropodes* Dissing. Basionym: *Peziza solitaria* Karst., Not. Sällsk. F. Fl. Fenn. Förh. 10:111. 1869. Synonyms: *Helvella queletii* Bres., fide Harmaja, 1977. *Paxina dupainii* (Boud.) Seaver, fide Dissing, 1966. *Paxina platypodia* (Boud.) Seaver, fide Dissing, 1966.

Apothecium: cupulate, with two lobes, 17-30 mm diam, hymenium brown, excipular surface blackish brown, pubescent. **Stipe:** equal, laterally compressed, solid, cream, pubescent, with a few blunt, inconspicuous ribs, 25 x 3-6 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 240 x 18 *um*. **Paraphyses:** hyaline or nearly so, enlarged to 5.5-7 *um* at apex. **Ascospores:** hyaline, broadly ellipsoidal, 17-20 x 11-13 *um*. **Habitat:** solitary on soil in deep duff under *Picea*. **Collections examined:** ALTA 8295, R. M. Danielson, July 25, 1973, Fish Creek Provincial Park.

Notes: According to Dissing (1966) and Weber (1972) *H. solitaria* is an extremely variable taxon with respect to size and colouration of the apothecium and the degree of ribbing on the stipe. Pale forms of *H. solitaria* have been recorded by Nannfeldt and Dissing (Dissing, 1966) and by Kempton and Wells (1970). Weber (1972) discusses two variants; one with a typically thin, solid stipe and few ribs, and one with a broader, often lacunose stipe and prominent ribs. Our material represents the thin, sparsely ribbed variant and has a typical dark brown hymenial surface. This species has been reported from Alberta by Larsen and Denison (1978) (as *H. queletii*). A discussion concerning the nomenclature of this taxon is included with the discussion of *H. confusa*.

Helvella villosa (Hedw. ex O. Kuntze) Dissing & Nannf., Svensk. Bot. Tidskr. 60:330. 1966. Figs. 71-74. Section *Macropodes* Dissing. Basionym: *Octospora villosa* Hedw., Species Muscorum Frond. 2:54, Tab. 19, Fig. B. 1788. Synonyms: *Cyathipodia villosa* (Hedw. ex O. Kuntze) Boud., fide Dissing, 1966.

Apothecium: shallowly cupulate to plane, margin may be split at maturity, 10 mm diam, hymenium drab grey, excipular surface sepia, villose. **Stipe:** equal, terete, solid, clay buff, villose, 30 x 3 mm. **Asci:** hyaline, cylindrical, tapering to base, up to 250 x 18 um. **Paraphyses:** hyaline, enlarged gradually to 5-7.5 um at apex. **Ascospores:** hyaline, broadly ellipsoidal, uniguttulate with several small oil drops at each end, 16.5-20 x 10-12 um. **Habitat:** solitary on the ground in deep litter under *Populus balsamifera*. **Collections examined:** ALTA 8289, R. M. Danielson, September 16, 1973, Fish Creek Provincial Park.

Notes: The combination of grey to grey brown apothecium and villose excipular surface and stipe serve to separate *H. villosa* from morphologicaly similar species in this section. *H. cupuliformis* Dissing & Nannf. is cream or pale grey yellow; *H. corium* (q.v.) is black, both have pubescence on the excipular surface and stipe. *H. brevis* (q.v.) and *H. macropus* (Pers. : Fr.) Karst. are easily separated on the basis of ascospore morphology. *H. villosa* has been reported from Alberta by Larsen and Denison (1978).

Acknowledgements

The authors are pleased to acknowledge Dr. R. M. Danielson, University of Calgary, and Dr. J. H. Ginns, Curator, DAOM for freely providing specimens for this study. J. R. Maywood prepared the illustrations, and A. Smreciu assisted in the preparation of the photographic plate. M. Hertwig prepared the latin diagnosis of *Helvella robusta*. The authors are grateful to Drs. Dissing, Paden, and Weber for critically reviewing the manuscript. This work was supported in part by a grant from the Natural Sciences and Engineering Research Council (NSERC) of Canada to RSC., and by an NSERC Undergraduate Student Research Award to SPA.

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ACAULOSPORA SPLENDIDA, A NEW SPECIES IN THE ENDOGONACEAE FROM COSTA RICA

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SUMMARY

Acaulospora splendida forms globose to irregular hyaline spores, 147 x 317 µm diam, with 2 wall groups having the 5 walls a total thickness of 2.5 - 5 µm. The collapsed translucent sporiferous saccule or a hyphal remnant is generally attached to spores collected from field samples. Spores do not sediment in water. The known distribution of this species is restricted to Costa Rica.

RESUMEN

Acaulospora splendida forma esporas hialinas, globosas a irregulares, 147 - 317 µm diam. Tienen 2 grupos de paredes y el grosor total de las 5 paredes es 2.5 - 5 µm. El sáculo esporífero o un fragmento de la hifa generalmente queda conectado a la espora en coleciones del campo. Las esporas no sedimentan en agua. Hasta la presente la nueva especie solamente se conoce de Costa Rica.

INTRODUCTION

Several species of vesicular arbuscular mycorrhizal fungi were found in soil of a two year old nursery planting of Quercus costaricensis Liebmann. Hyaline spores of an undescribed species of Acaulospora Gerd. & Trappe were found in addition to A. scrobiculata Trappe; Entrophospora infrequens (Hall) Ames & Schneider; E. schenckii Siev. & Toro;

Scutellospora calospora (Nicol. & Gerd.) Walker & Sanders; S. coralloidea (Trappe, Gerd. & Ho) Walker & Sanders; S. gilmorei (Trappe & Gerd.) Walker & Sanders; S. pellucida (Nicol. & Schenck) Walker & Sanders, and S. savannicola (Herr. & Ferr.) Walker & Sanders. Spores of the new species were mounted in polyvinyl-alcohol-lactophenol (PVL), lactophenol and Melzer's reagent. Spores were stored in 5% formalin. Wall descriptions follow the terminology of Walker (1983). Diameter was determined from 125 spores, wall measurements are from 50 spores.

ACAULOSPORA SPLENDIDA sp. nov. Sieverding, Chaverri & Rojas (Fig. 1 and 2).

Sporae singulae in solo formatae; sporae hyalinae, globosae vel subglobosae vel irregulares, (147) 209-317 x (133) 157-264 µm diam. Sporae lateraliter gestae ad collum sacculi sporangiferi. Sacculus sporiferis hyalinus, globosus vel irregularis, 160-300 x 150-200 µm diam. Distantia inter sporam et sacculum sporiferum 30-75 µm longa; sacculus ad maturitatem sporae generatim non evanescens. Paries sporae e startis quinque: exterius, 0.3-0.7 µm crassum, continuum cum pariete sacculi sporiferi; startum secundum rigidum, 1-2 µm crassum, adherens a strato primo. Stratum tertium membranosum, 0.2-0.5 µm crassum, et quartum rigidum, 0.5-1 µm crassum, separabile vel adherentes. Stratum quintum rigidum, 0.5-1 µm in aqua, in lactophenolio dilatatum.

Spores formed singly in soil, hyaline (glistens in water), shiny smooth, globose or subglobose, 190 - 250 µm diam., ovoid, oblong, broadly ellipsoid, broadly rectangular, or triangular with round edges or irregular, (147) 209 - 317 x (133) 157 - 264 µm diam. Spores borne laterally on a tapering hypha, 25-52 µm wide at point of spore attachment; pore at point of attachment 6-11 µm diam., closed by second spore wall.

Sporiferous saccules globose, broadly ellipsoid or irregular in shape, 160-300 x 150-200 µm diameter, slightly constricted at the neck. Wall is 0.3-0.7 µm thick. After spore formation the sporiferous saccule becomes translucent and may collapse, but usually remains attached to the spore. Distance between sporiferous saccule and spore 30-75 µm.

Spore wall structure (Fig. 1 b, c, d and Fig. 2) of five hyaline walls (walls 1-5) in 2 wall groups (A&B), having a total thickness of 2.5-5.0 µm.

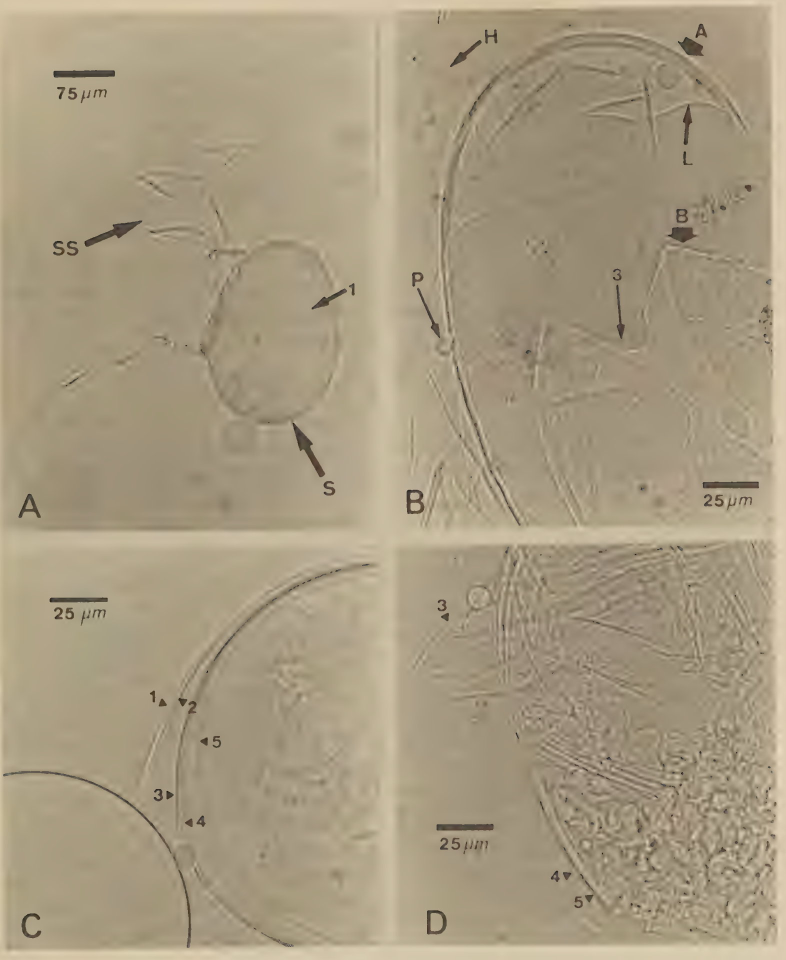

Figure 1. Microphotographs of Acaulospora splendida. A) Spore (S) with usually attached hypha and sporiferous saccule (SS); wall 1 is broken and wrinkles. B) Broken spore showing two wall groups (A&B); wall 1 is continous with the wall of the attached hypha (H), see the pore (P); note the fine wrinkled wall 3 on wall group B; the line (L) is the periphere of the out-flowing oily spore content. C) Broken spore showing 5 walls (1-5); walls 1&2 and 3&4 are adherent, wall 5 is swollen in lactophenol. D) Wall group B of spore with walls 3, 4 & 5; wall 3 wrinkles, walls 4 & 5 are unit walls and usually adherent.

Wall group A with two walls (1 & 2); outer wall (wall 1), 0.3-0.7 µm thick, continous with wall of tapering hypha on which spore is borne, adherent to a unit wall 2, 1-2 µm thick; walls 1 & 2 often appear as one single wall. Wall group B of three walls (walls 3, 4 & 5); wall 3, a membranous wall, 0.2-0.5 µm thick, usually adherent to wall 4, a unit wall, 0.5-1 µm thick; walls 3 & 4 can appear as a single wall; wall 5 is a unit wall, 0.5 -1 µm thick in water, 2-3 (-6) µm thick when spores are stored in formalin or lactophenol; wall 5 occasionally separates from wall 4; wall 5 stains reddish-brown in Melzer's reagent when fresh mounted or after storing in formalin.

Type of mycorrhiza unknown.

HOLOTYPE: Costa Rica, Heredia, Concepción de San Rafael, in nursery bed with Quercus costaricensis; GOET. Isotypes; OSC.

ETYMOLOGY: splendida (latin, adj.) referring to the sparkling of the hyaline spores under incident light.

DISTRIBUTION: Only known from Costa Rica. The nursery seed bed where A. splendida was found had been planted with Q. costaricensis two years previously. The soil (37% sand, 47% loam, 16% clay, 12.5% organic matter) had the following chemical characteristics: pH 5.9; 0.15 meq Al, 7.5 meq Ca, 1.0 meq Mg and 0.49 meq K / 100 ml soil; 8 µg P, 5.4 µg Zn, 4 µg Mn, 7 µg Cu and 40 µg Fe / ml soil, extractable.

MYCORRHIZAL ASSOCIATIONS:In the nursery with Q. costaricensis and weeds belonging mostly to the Compositae and Gramineae. Attempts to establish pot cultures with sorghum failed.

DISCUSSION: Spores of A. splendida are always hyaline with a smooth surface. Some spores obtained from the field had light yellow or brown shaded areas on the surface; those were contaminated by other fungi growing on the spore surface. Spores of A. splendida float on the surface of water and other liquids; care should be taken not to decant spores in the process of extraction from soil.

The size of spores and spore wall structure separate A. splendida from other species of the genus with smooth hyaline spores. Spores of A. delicata Walker, Pfeifer & Bloss, A. longula Spain & Schenck, A. myriocarpa Spain, Siev. &

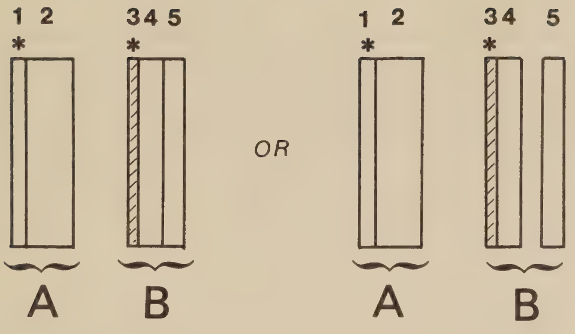

Figure 2. Murograph of walls of Acaulospora splendida. Five walls (1-5) in two wall groups (A, B). Walls 1 and 3 are difficult to observe (*).

Schenck, and A. trappei Ames & Linderman are smaller in size. In contrast to A. splendida, spores of A. nicolsonii Walker, Reed & Sanders have an evanescent thin outer wall and a laminated second wall.

Some of the walls of A. splendida are difficult to discern. Broken spores readily show two wall groups (Fig. 1B). Wall 1 is very difficult to observe; on most specimens walls 1 & 2 are strongly adherent and appear as one single wall. Wall 1 was detected on some specimens because the wall wrinkled remaining attached to wall 2 (Fig. 1A). Walls 3 & 4 may also appear as a single wall; the two walls can be distinguished by the wrinkling of wall 3 (Fig. 1D); wall 4 is usually adherent to wall 5 (Fig. 1D), but may be separated from latter wall on some specimens (Fig. 1C). Wall 5 stains a reddish-brown color in Melzer's reagent; this wall is not a amorphous wall as described by Morton, 1986a; the increase of wall thickness may have been due to mounting media as was reported by Morton (1986b). On few of freshly extracted specimens from one collection date we found between wall groups A & B a ≤0.2 µm thin membrane which was adherent to or separated from wall group A; when squashed the membrane appeared granular breaking down to form a viscous and stringy mass. The membrane was not included in the description since its observation was not reproduced in spores from other collection dates.

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NOTES ON SELECT CORTICIACEOUS FUNGI FROM SPAIN AND NORTH AFRICA

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ABSTRACT

Four species of *Corticiaceae s.l.* are treated from Spain and supplied with descriptions and/or brief comments. Among them *Epithele canariensis* and *Hyphoderma malençonii* are proposed as new combinations. *Hyphoderma galactinum* is proposed as a new taxon. *Corticium moniliforme* reported by Talbot from Africa, is transferred to *Hyphoderma* and a key to the species with moniliform cystidia is provided. Finally, *Fibricium multicystidium* is found to be a synomym to *Hyphoderma sabinicum.*

EPITHELE CANARIENSIS (Manjón & Moreno) Hjortstam, Manjón & Moreno, *comb. nov.*
Basionym: *Cerocorticium canariensis* Manjón & Moreno in Bot. Macaronésica 10:29 (1982).

This is a typical species of *Epithele (Pat.) Pat.* and is found exclusively on *Phoenix spp.* The closest relative seems to be *E. hydnoides* Burt which has larger spores, about 8-13 μm in diam. For description and figure of *E. canariensis*, see Manjón & Moreno *l.c.*

We support the opinion by Boidin and Lanquetin (1983) and include *Skeletohydnum* Jülich (1979) in *Ephithele.* Another genus, *Epithelopsis* Jülich (1976), described to accomodate *Epithele fulva* G.H. Cunn. (1956), is a well defined taxon, separated by thick-walled, slightly dextrinoid and strongly cyanophilous spores. The hyphal pegs are composed of thick-walled and non-clamped hyphae (skeletals), which are iniatially more o less hyaline then brownish. *Epithele fulva* is hitherto known only from New Zealand, the collection reported from Africa by Ryvarden (1978) belongs to *Epithele*, but the species identity is uncertain.

Additional specimens examined: Spain, Cádiz, Benamahoma, on living stem of *Phoenix spp.*, 15 March 1984, leg. G. Moreno, J.L. Manjón, R. Galán, A. Ortega & M. Honrubia, HAH 10804. Spain, Cáceres, Miajadas, on living stem of *P. canariensis*, 2 November 1987, leg. G. Moreno, F. Esteve-Raventós & C. Illana, HAH 10606.

HYPHODERMA GALACTINUM Manjón, Moreno & Hjortstam, *sp. nov.*

Corpus fructiferum resupinatum 0,1-0,2(-0,3) mm altum, glabrum, nitido colore albo, annum. Margo paucum patet. Hypharum systema monomiticum, generativis hyphis constitutum, fibulatis, quarum est diameter 2,5-3(-4) longus. Sporae cylindricae sive suballantoideae, 13-16 μm longae, 4-4,5 μm latae, hyalinae, laevis parietibus subtilibusque, frequentibus vacuolis, haud amyloideae. Basidia sive subclavata sive subventricosa, 25-35 μm longa, 7-8-(-10) μm lata, tetrasporica. Cystidia cylindrica, capitato apice, interdum sinuosa subcapitato apice, 40-80(-100) μm longa, 6-10 μm lata, frequentia ac plerumque e basidiali strato emergentia.
Habitat: "Los Quejigales, Sierra de las Nieves *(Malaca) in lignis ramorum mortuorum Abietis pinsapo* (HAH 5816).

Holotypus: Spain, Málaga, Sierra de las Nieves, Los Quejigales, on fallen log of *Abies pinsapo*. 3 May 1985, leg. G. Moreno, J.L. Manjón, R. Galán & M.N. Blanco, HAH 5816.
Isotypus: in MA-Fungi. Isoparatypus: HAH 5797 in GB.

Basidiome resupinate, effused, loosely adnate but not easily removed, about 0,1-0,2(-0,3) mm thick, hymenophore at first discontinuous, then continuous, mostly smooth or slighty tuberculate, sometimes deeply cracking, milky white, margin concolorous, indeterminable. Hyphal system monomitic; subicular hyphae thin-walled, hyaline, with clamp-conexions, 2,5-3(-4) μm wide, smooth or lightly encrusted, regularly branching at more or less right angles, forming a thin and relatively loose layer, subhymenial hyphae similar, but denser. Cystidia frequent, 40-80(-110) μm long and about 6-10 μm wide at center, usually arising from the subhymenial layer, embedded or more commonly projecting above the basidia, cylindrical, narrowing towards the base, often more or less moniliform with several constrictions, thin-walled or with slight wall thickening, negative in sulpho-vanillin. Basidia subclavate, often typically stalked, with oily contents, 25-35x7-8(-10) μm, with four sterigmata, with a basal clamp-connexion. Spores cylindrical to suballantoid, sometimes sigmoid, thin-walled, but with oily inclusions, 13-16x4-4,5 μm. (Figs. 1-2).

Additional specimens: Spain, Málaga, Estepona, Sierra de los Reales, on dead branches log of a living *Abies pinsapo*, 14 March 1984, leg. G. Moreno, J.L. Manjón, M. Honrubia, A. Ortega & R. Galán, HAH 5797 & 5817.

Remarks: *Hyphoderma galactinum* is similar to *H. definitum* (Jaks.) Donk and *H. subdefinitum* John Erikss. & Strid but they are distinguished by the colour, basidiome size, cystidia, basidia and spores. The spores are important for determination. Those of *H. galactinum* are narrower and thus intermediate between *H. definitum* and *H. subdefinitum*.

Table 1: Comparison between ***Hyphoderma definitum*, *H. subdefinitum*** and ***H. galactinum***

Basidiome colour	*white-greyist*	*white-greyist*	*milky white*
Basidiome thickness	*0,5 mm*	*0,05-0,1 mm*	*0,1-0,2(-0,3) mm*
Cystidia	*50-75x6-7 μm*	*50-75x6-8 μm*	*40-80(-110)x6-10 μm*
Basidia	*25-40x6-8 μm*	*35-50x6-8 μm*	*25-35x7-8 μm*
Spores	*12-14x3-3,5 μm*	*10-14x4,5-6 μm*	*13-16x4-4,5 μm*

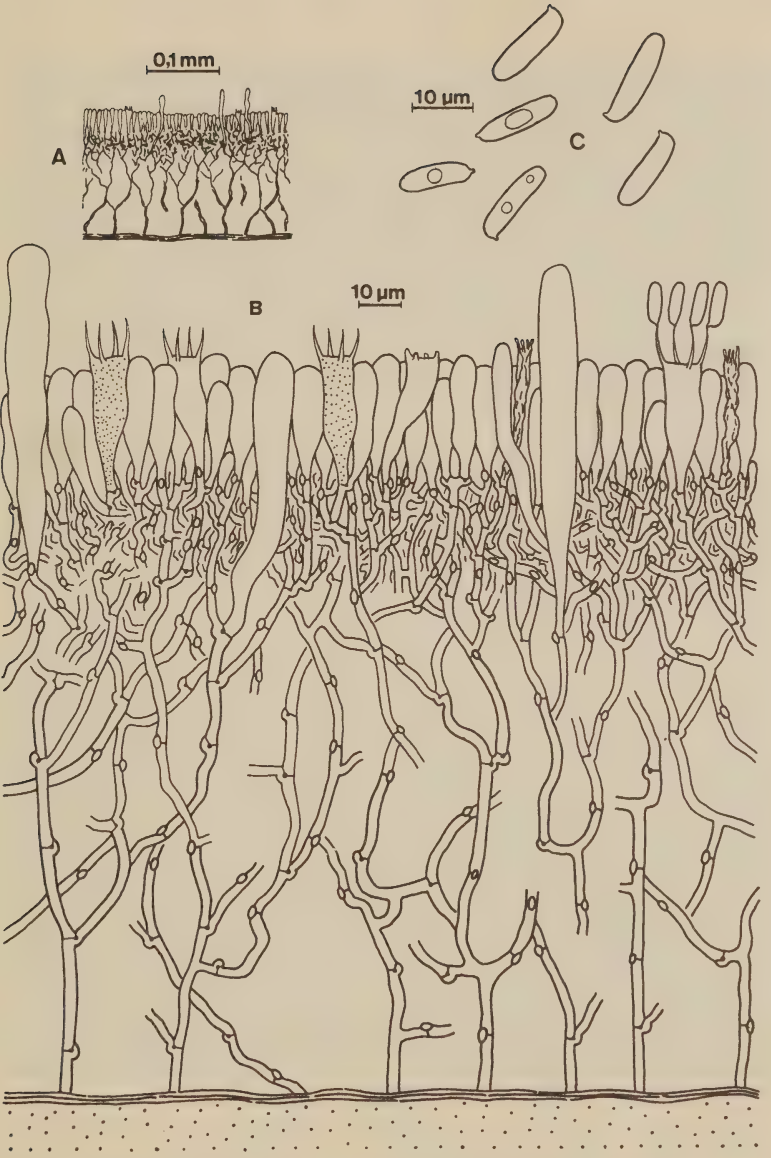
0,1 mm
A
10 µm
C
B
10 µm

Fig. 1. Hyphoderma galactinum. A, Section through mature fruitbody; B, Hymenium with projecting cystidia, basidia and spores; C, Spores.

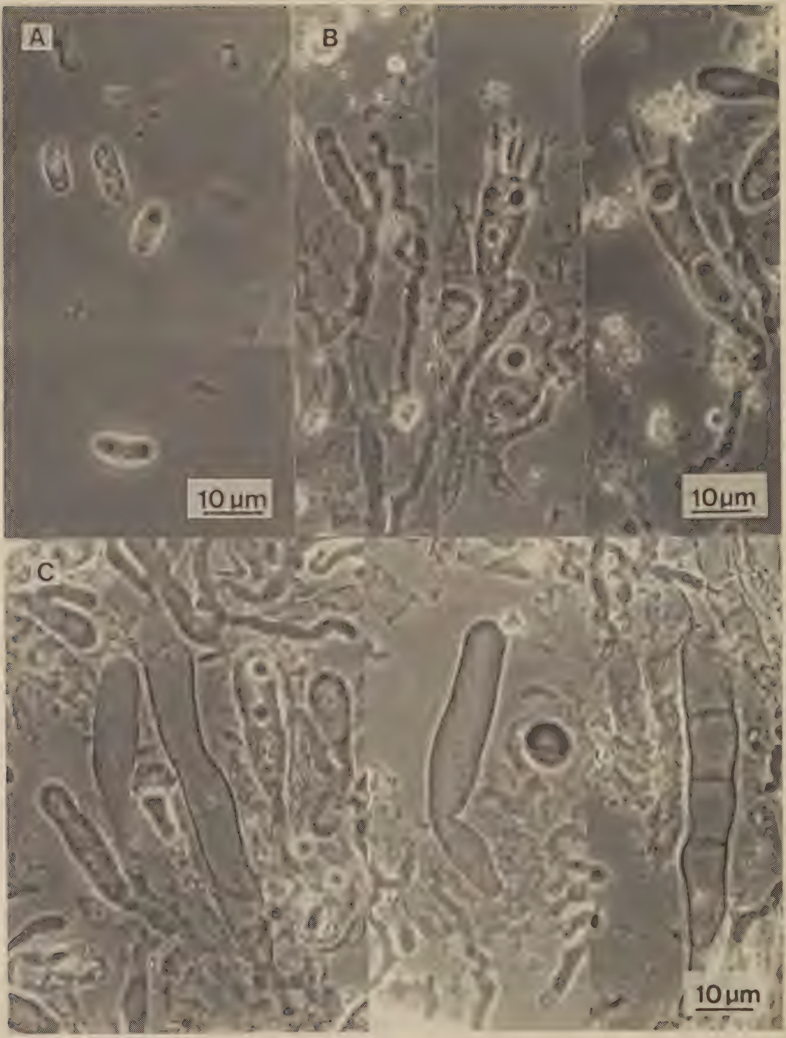
A
B
C
10 µm
10 µm
10 µm

Fig. 2. *Hyphoderma galactinum.* A, Spores; B, Basidia; C, Cystidia.

HYPHODERMA MALENÇONII (Manjón & Moreno) Manjón, Moreno & Hjortstam, *comb. nov.*
Basionym: *Dendrothele malençonii* Manjón & Moreno in Cryptogamie Mycol. 4:147(1983).

Hyphoderma malençonii is similar to the above mentioned species, but, has longer spores, up to 12-15 µm long. Further, it is found only on *Abies pinsapo*. It was observed by Malençon (1968), who gave it a good description within *Aleurodiscus*, but without a formal diagnosis. The dendrohyphidia mentioned and figured by two of us, Manjón and Moreno, are not always present or may be very rare in some specimens. Further, the subiculum and the basal part of the fruitbody is richly branched and densely interwoven.

Additional specimens examined: Spain, Cádiz, Grazalema, on log of *Abies pinsapo*, 21 April 1982, leg. F.D. Calonge, M.T. Tellería & M. Dueñas, MA-Fungi 9963. *Ibidem*, 1 May 1985, leg. G. Moreno, J.L. Manjón, R. Galán & A. Ortega, HAH 10797 to 10803.

Marocco, Meknès, Jebel Hebri, on log of *?Quercus ilex*, 19 June 1982,leg. J. Fdez. Casas, F. Muñoz Garmendia, A. Susanna & M.T. Tellería, MA-Fungi 5515 & 5516.

HYPHODERMA MONILIFORME (Talbot) Manjón, Moreno & Hjortstam, *comb. nov.*
Basionym: *Corticium moniliforme* Talbot in Bothalia 7:144(1958).

The species is similar to *Hyphoderma litschaueri* (Burt) John Erikss. & Strid (1975), but has more distinctly moniliform cystidia. Hitherto unknown outside southern Africa. For a good description see Talbot *l.c.*

New collections of *Hyphoderma moliniforme* are needed to clarify the taxonomic position of this species.

Specimen examined: type, 36899, *Corticium moniliforme* Talbot, host: dead wood, loc.: Hennops River, Pretoria (South Africa).

KEY TO HYPHODERMA WITH MONILIFORM CYSTIDIA

1. Spores 12-15 µm long; cystidia strongly moniliform; basal hyphae richly branched and densely interwoven ....*H. malençonii*
1. Spores shorter, usually 8-10 µm long; basal hyphae sparsely branched 2
2. Cystidia strongly moniliform, bulges mostly globose. African species ....H. moniliforme
2. Cystidia less moniliform, bulges mostly elongated. North Europe and North American species ....*H. litschaueri*

HYPHODERMA SABINICUM Manjón & Moreno in Anales Jard. Bot. Madrid 40:12(1983).
≡ *Crustoderma sabinicum* (Manjón & Moreno) Nakasone in Mycotaxon 22:415(1985).
= *Fibricium multicystidium* Hjortstam & Ryvarden in Mycotaxon 12:175(1980) *non Hyphoderma multicystidiatum* Ryvarden in Bull. Jard. Bot.

Natl. Belgique 48:86(1978), homonym.

Basidiome resupinate, effused, adnate, 0,1-0,3 mm thick, mostly cracking deeply, white to creamish, sublente with protruding cystidia. Margin usually abrupt or sometimes fibrillose and then skeletal hyphae easily found. Hyphal system dimitic: skeletal hyphae (fibre-hyphae) thick-walled, without clamp-connexions, 2-2,5 µm wide; generative hyphae thin to moderately thick-walled, rather narrow, 2-2,5 µm and conspicuously straight and uniform, slightly encrusted, basidia-bearing hyphae wider, all generative hyphae with clamp-connexions. Cystidia normally numerous, thin-walled, cylindrical with an obtuse apex, constricted, about 70-90 µm long, often considerably longer and up to 200 µm long, expanded towards the apex, with no sulpho-vanillin reaction. Hyphal ends occur between the basidia. Basidia clavate, usually with pedunculate appearance, more or less sinuous, normally with four sterigmata, 35-40(-50)x5-7 µm. Spores ellipsoid, smooth, thin-walled or with slight wall thickening, with oily inclusions, 7-9(-10)x3,5-4,5(-5) µm, inamyloid, acyanophilous and non-dextrinoid.

Remarks: *Hyphoderma sabinicum* is a well known species in southern Spain were it is found several times on *Juniperus thurifera* (the type of *Fibricium multicystidium* is on *Erica arborea*). Presumably Malençon (1982) found the same fungus on *Abies pinsapo* in Marocco when he reported it under the name "*Fibricium* sp."

The position of this species in *Hyphoderma* is doubtful. It resembles other species in the genus by the oil-rich spores and somewhat thick-walled, tubular cystidia, but as it also posesses skeletal hyphae (fibre-hyphae), so the generic concept of *Hyphoderma* will be wider. On the other hand, *Fibricium* is a clearly defined taxon with rather small, about 5-6 µm long, spores and hyphae similar to those of *Hyphodontia*. In addition, it has fibre-hyphae and Parmasto (1986) placed it in *Steccherinaceae*.

Most specimens of *Hyphoderma sabinicum* lack or seemingly lack fibre-hyphae, or they can only be found at the margin. Such hyphae were not observed and described in the original description and we have not seen them it during re-examination of the holotype, but we are convinced that it is the same as *Fibricium multicystidium*.

It should also be mentioned that Nakasone (1985) transferred *Hyphoderma sabinicum* into the genus *Crustoderma* Parm. owing to its similarity with *C. dryinum* (Berk. & Curtis) Parm. Further, she was also of the opinion that a paratype (5043) of *H. sabinicum* was not conspecific with the type (5614). We believe either that *H. sabinicum* can be placed into the same genus as *C. dryinum* or that 5043 is different and should be an independent species. The similarity to *Crustoderma* is superficial owing to the shape of the cystidia (for description and figure of *C. dryinum* see Eriksson & Ryvarden (1975).

Selected specimens examined: Spain, Canary Islands, Ryv. 12363 (type of *Fibricium multicystidium*) O; isotype in GB; Guadalajara, H.JLM-GM 5614 (type of *Hyphoderma sabinicum*), 5043, 5069 (*sub F. multicystidium*), 5072, 5078, 5615 (*sub F. multicystidium*), 5616, 5728 & 5729 (the two latter *sub F. multicystidium*); León, on *Juniperus* MA-Fungi 10080 (*sub Calvulicium sp.* det. Tellería).

Marocco: Meknès, Jebel Hebri, on log of *Cedrus atlantica*, 19 June 1982, leg. J. Fdez. Casas, F. Muñoz Garmendia, A. Susanna &. M.T. Tellería, MA-Fungi 5636, 5637, 5638 (on *Quercus ilex*), *5639 (on ? Cedrus atlantica)*

& 5640; Tétouan, Bab-Taza, Ej Jebrel Lakraa, on log of *Quercus ilex, 24 June 1982, leg. ibidem*, MA-Fungi 9849 & 9850 (the two latter *F. multicystidium*).

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Annotated Check-list with Host Data and Decay Characteristics for Colorado Wood Rotting Basidiomycotina

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Numerous researchers have collected wood-rotting fungi in Colorado, but a comprehensive check-list with host data and decay relationships has never been assembled. Additionally, most collections have been restricted to the more conspicuous Agaricales and polyporaceous Aphyllophorales. The Corticiaceae, a family with many wood-inhabiting species, has been poorly collected.

Lists of fungi from Colorado were obtained from the National Fungus Collection, the Rocky Mountain Forest and Range Experiment Station, the University of Arizona Mycological Herbarium, and the Fort Lewis College Mycological Herbarium. Additional records from the state were obtained from the following publications: Gilbertson **et al.** 1979; Gilbertson and Ryvarden 1986, 1987; Lindsey 1985, 1986a, 1986b, 1987; Lowe 1966; Lowe and Gilbertson, 1961; Martin and Gilbertson 1977, 1978, 1980; Overholts 1953; and Shope 1931. Fungal species that were unidentifiable as listed in a record were not included in this publication. Listings of the species are alphabetical by order and family. Each listing has three parts: the current fungus name and authority; a description of the type of wood decay (if available); and any reported Colorado host relationship (acronyms for hosts are listed below). Host information for each species was listed as: "conifer"; "hardwood"; by genus of the host when specific epithets were not available; or by species of the host when this was included in a record.

Acronyms for host species are: ABCO = **Abies concolor** (Gord. et Glend.) Lindl.; ABLA 1 = **Abies lasiocarpa** v. **lasiocarpa** (Hook.) Nutt.; ABLA 2 = **Abies lasiocarpa** v. **arizonica** (Merriam) Lemm.; ABMA = **Abies magnifica** A. Murr.; ACGL = **Acer glabrum** Torr.; ACNE = **Acer negundo** L.; ACRU = **Acer rubrum** L.; ACSA = **Acer saccharinum** L.; AIAL = **Ailanthus altissima** (Mill.) Swingle; ALTE = **Alnus tenuifolia** Nutt.; ARTR = **Artemisia tridentata** Nutt.; BEOC = **Betula occidentalis** Hook.; CUSA = **Cupressus sargentii** Jeps.; GLTR = **Gleditsia triacanthos** L.; HAVI = **Hamamelis virginiana** L.; JUMO = **Juniperus monosperma** (Engelm.) Sarg.; JUOS = **Juniperus osteosperma** (Torr.) Little; JUSC = **Juniperus scopulorum** Sarg.; PIAR = **Pinus aristata** Engelm.; PICO = **Pinus contorta** Dougl. ex Loud.; PIED = **Pinus edulis** Engelm.; PIEN = **Picea engelmannii** Parry ex Engelm.; PIFL = **Pinus flexilis** James; PILA = **Pinus lambertiana** Dougl.; PIPO = **Pinus ponderosa** Laws.; PIPU = **Picea pungens** Engelm.; QUGA = **Quercus gambelii** Nutt.; POAL = **Populus alba** L.; POAN = **Populus angustifolia** James; POSA = **Populus sargentii** Dode; POTR = **Populus tremuloides** Michx.; PRAM = **Prunus americana** Marsh.; PRVI = **Prunus virginiana** L.; PSME = **Pseudotsuga menziesii** (Mirb.) Franco; SHAR = **Shepherdia argentea** (Pursh) Nutt.

Annotated Checklist with Host Data
and Decay Characteristics for Colorado
Wood-rotting Basidiomycotina

HYMENOMYCETES: HOLOBASIDIOMYCETIDAE

Agaricales

Armillaria mellea (Vahl:Fr.) Quél. (sensu lato); Parasitic white rot of roots and butt of living and dead conifers and hardwoods; ABCO, ABLA 1, PICO, PIEN, PIPU, POTR, QUGA

Collybia acervata (Fr.) Kumm.; White rot; ABLA 2

Crepidotus mollis (Schaeff.:Fr.) Kumm.; White rot of hardwood logs, esp. aspen; POAN, POTR

Flammulina velutipes (Curt.:Fr.) Sing.; White butt rot and heartrot of living and dead conifers and hardwoods, esp. aspen; PIEN, POTR

Galerina autumnalis (Pk.) A.H. Smith et Singer; on very rotten conifer and hardwood; PIEN

Gymnopilus sapineus (Fr.) Maire; Rot not determined; PICO, QUGA, Populus

Hypsizygus marmoreus (Pk.) H. Bigelow; Brown rot of hardwoods; POTR

Lentinellus cochleatus (Fr.) Karst.; White rot of dead conifers and hardwoods; POTR, QUGA

Lentinellus montanus O.K. Miller; White rot of conifer logs; PIEN

Lentinellus ursinus (Fr.) Kühner; White rot of dead hardwoods and conifers; ABCO, POTR

Mycena overholtsii A.H. Smith et Solheim; Rot not determined; PIEN

Neolentinus lepideus (Fr.:Fr.) Redhead et Ginns; Brown cubical rot of conifer stumps and living trees; ABCO, PICO, PIPO

Neolentinus ponderosus (O.K.Miller) Redhead et Ginns; Brown cubical rot of ponderosa pine logs and stumps; PIPO

Panus rudis Fr.; White rot of hardwood logs and slash; POTR, QUGA

Phaeomarasmius erinaceus (Fr.) Kühner; White rot of dead oak limbs and slash; QUGA

Pholiota adiposa (Fr.) Kumm.; White rot of dead conifers and hardwoods; PIEN, POTR

Pholiota alnicola (Fr.) Sing.; Rot not determined; ABLA 1, PIEN

Pholiota decorata (Murr.) A.H. Smith et Hesler; White rot of conifer and hardwood logs and slash; ABCO

Pholiota destruens (Brond.) Gillet; White rot of dead Populus; POSA

Pholiota spumosa (Fr.) Sing.; White rot; ABLA, PIEN

Pholiota squarrosa (Fr.) Kumm.; White butt and root rot of living hardwoods and occasional conifers, but common on aspen; ABLA 1, PIEN, PIPO, POTR

Pleurotus ostreatus Jacq.:Fr.; White rot of trunks and butt of dead conifer and hardwoods; ABLA 1, ALTE, PIED, POAL, POTR, Picea

Pluteus cervinus (Schaeff.:Fr.) Kumm.; White rot of conifer and hardwood logs and slash; ABCO, POTR

Psathyrella candolleana (Fr.) A.H. Smith; White rot of well-decayed hardwoods; ACSA

Resupinatus applicatus (Batsch:Fr.) S.F. Gray; White rot of dead hardwoods and conifers; QUGA

Schizophyllum commune Fr.; White rot of hardwood logs and slash; AIAL

Tricholomopsis platyphylla (Fr.) Sing.; White rot of hardwood and conifer logs and slash; POTR, QUGA

Tricholomopsis rutilans (Fr.) Sing.; White rot of conifer logs and slash; PIEN
Xeromphalina campanella (Batsch:Fr.) Kühner and Maire; Rot not determined; PIEN

Aphyllophorales

Clavariaceae

Clavicorona pyxidata (Fr.) Doty; White rot of conifer and hardwood logs and slash, esp. aspen; POTR

Coniophoraceae

Coniophora arida (Fr.) Karst. var. **arida**; Brown rot of dead conifer and hardwood slash; PICO, PIEN, POTR
Coniophora arida var. **suffocata** (Pk.) Ginns; Brown rot of conifer and hardwood slash; Abies
Coniophora olivacea (Pers.) Karst.; Brown rot of dead conifer and hardwood slash; ABLA 1, PICO, PIEN
Coniophora puteana (Schum.:Fr.) Karst.; Brown cubical rot of dead conifers and occasional hardwoods; PIEN, Abies
Serpula himantioides (Fr.:Fr.) Karst.; Brown rot of conifers and hardwoods; PIEN

Corticiaceae

Aleurodiscus amorphus (Pers.:Fr.) J. Schroet.; White rot of dead conifer branches; sometimes pathogenic on young Abies sp.; PIEN, PIPU, Abies
Aleurodiscus cerrusatus (Bres.) Hoehn. et Litsch.; White rot of dead branches and slash of conifers and hardwoods; JUOS, PSME, QUGA
Aleurodiscus fruticetorum W.B. Cooke; White rot; ARTR
Aleurodiscus lividocoeruleus (Karst.) Lemke; White rot of fallen conifers and hardwoods; ABLA 1, PICO, PIEN, PIPO, POTR
Aleurodiscus mesaverdensis Linds.; Living bark of piñon, causing a white rot; PIED
Amphinema byssoides (Pers.:Fr.) John Erikss.; White rot of dead hardwoods and conifers; sometimes found growing on damp soil and rocks; an extremely common and macroscopically variable fungus; ABCO, ABLA 1, PIEN, PIPU, POTR, PSME, QUGA
Athelia bombacina (Pers.) Jülich; White rot of dead conifers and hardwoods; PIED, PIEN, QUGA
Athelia coprophila (Wakef.) Jülich; White rot; QUGA
Athelia decipiens (Hoehn. et Litsch.) John Erikss.; White rot of dead conifers and hardwoods; ARTR, PIEN
Athelia microspora (Karst.) Gilbn.; White rot of conifers; PIPU
Botryobasidium botryosum (Bres.) John Erikss.; White rot; QUGA
Botryobasidium pruinatum (Bres.) John Erikss.; White rot of conifers; PIEN, PIPO
Botryobasidium subcoronatum (Hoehn. et Litsch.) Donk; White rot of conifers and hardwoods; PICO
Botryobasidium vagum (Berk. et Curt.) Rogers; White rot of dead conifers; ABLA, PIEN, PIPO
Botryohypochnus isabellinus (Fr.) John Erikss.; White rot of conifers and hardwoods; POTR

Caerulicium neomexicanum (Gilbn. et Budingt.) Jülich; White rot of conifers; PIPO
Ceraceomyces borealis (Rom.) John Erikss. et Ryv.; White rot of conifers; PIPO
Ceraceomyces serpens (Fr.) Ginns; White rot of conifers and hardwoods; POTR, QUGA
Ceraceomyces sublaevis (Bres.) Jülich; White rot; PIEN
Ceratobasidium cornigerum (Bourd.) Rogers; Rot not determined; QUGA
Crustoderma dryinum (Berk. et Curt.) Parm.; Brown rot of dead conifers, Picea and mine timbers
Cylindrobasidium corrugum (Burt) Ginns; White rot particularly of high elevation conifers; fruits abundantly under snow; ABLA 1, ABLA 2, PIEN, PIFL, PIPU, Juniperus
Cylindrobasidium evolvens (Fr.:Fr.) Jülich; White rot of conifer and hardwood logs; ABLA 1, PICO, POTR
Dacryobolus karstenii (Bres.) Oberw. ex Parm.; Brown cubical rot of Pinus spp.; PICO
Fibricium rude (Karst.) Jülich; White rot of conifer and hardwood slash; Conifer
Fibulomyces mutabilis (Bres.) Jülich; White rot of conifer and hardwood slash; PIPO, QUGA
Gloeocystidiellum leucoxanthum (Bres.) Boid.; White rot of conifers and hardwoods; PIEN
Gloeocystidiellum porosum (Berk. et Curt.) Donk; White rot of dead conifers and hardwoods; ABLA 1, PIPU, POTR
Hyphoderma amoenum (Burt) Donk; White rot of conifers and hardwoods; Picea
Hyphoderma anasaziense Linds.; White rot of Quercus gambelii in Colorado; known only from the type collection; QUGA
Hyphoderma argillaceum (Bres.) Donk; White rot of dead conifers and hardwoods; PIEN, POTR
Hyphoderma cremeoalbum (Hoehn. et Litsch.) Jülich; White rot; PIEN
Hyphoderma medioburiense (Burt) Donk; White rot of conifers and hardwoods; ABLA 1, PIEN, QUGA
Hyphoderma mutatum (Pk.) Donk; White rot of aspen logs and slash; POTR
Hyphoderma pratermissum (Karst.) John Erikss. et Strid.; White rot of dead conifers and hardwoods; ALTE, PIEN, PIPO, PIPU, POTR, QUGA
Hyphoderma puberum (Fr.) Wallr.; White rot of conifers and hardwoods; ABLA 1, PICO, PIEN
Hyphoderma sambuci (Pers.) Jülich; White rot of conifers; ABLA 1, PIPU
Hyphoderma setigerum (Fr.) Donk; White rot of hardwoods; QUGA
Hyphoderma sibiricum (Parm.) John Erikss. et Strid.; White rot of conifers; Picea
Hyphodontia alutacea (Fr.) John Erikss.; White rot of dead conifers and hardwoods; Picea
Hyphodontia alutaria (Burt) John Erikss.; White rot of dead conifers; PIEN
Hyphodontia arguta (Fr.) John Erikss.; White rot of dead conifers and hardwoods; PIEN, QUGA
Hyphodontia aspera (Fr.) John Erikss.; White rot; QUGA
Hyphodontia breviseta (Karst.) John Erikss.; White rot of dead conifers and hardwoods; PICO
Hyphodontia crustosa (Pers:Fr.) John Erikss.; White rot of conifers and hardwoods; especially common on dead, attached branches of Quercus gambelii; PIEN, PIPO, PIPU, QUGA
Hyphodontia floccosa (Bourd. et Galz.) John Erikss.; White rot; QUGA

Hyphodontia hastata (Litsch.) John Erikss.; White rot; QUGA

Hyphodontia pallidula (Bres.) John Erikss.; White rot of conifers and hardwoods; PIEN

Hyphodontia spathulata (Schrad.:Fr.) Parm.; White rot of conifers and hardwoods; ALTE, PIEN

Hyphodontia subalutacea (Karst.) John Erikss.; White rot of conifers and hardwoods; ABLA 1, PIEN, PIPO, PIPU, POTR, QUGA

Hypochnicium bombycinum (Sommerf.:Fr.) John Erikss.; White rot of conifers and hardwoods; QUGA, *Acer*

Kavinia alboviridis (Morgan) Gilbn. et Budingt.; White rot of conifers and hardwoods; PICO, QUGA, *Picea*

Kavinia himantia (Schw.) John Erikss.; White rot of hardwoods; QUGA

Knieffiella fibrosa (Berk. et Curt.) M.J. Larsen; Rot not determined; PIPO

Laeticorticium roseum (Pers.:Fr.) Donk; White rot of hardwoods; POTR

Leptosporomyces galzinii (Bourd.) Jülich; White rot of conifers and hardwoods; PIEN

Leptosporomyces mundus (Jacks. & Deard.) Jülich; White rot of conifer; Conifer

Leucogyrophana mollusca (Fr.) Pouz.; White rot of dead conifers, especially *Pinus ponderosa*; PIPO

Leucogyrophana olivascens (Berk. et Curt.) Ginns et Weresub; White rot; PIPU

Leucogyrophana pseudomollusca (Parm.) Parm.; Brown rot; PIEN

Meruliopsis albostramineus Torr.; White rot of dead conifers; *Pinus*

Meruliopsis ambiguus (Berk.) Ginns; White rot of dead conifers; PICO

Meruliopsis hirtellus (Burt) Ginns; White rot of conifers and hardwoods; PIEN

Mycoacia fuscoatra (Fr.:Fr.) Donk; White rot of hardwood logs and slash; POTR

Odontia coloradensis Overh.; White rot; HAVI

Odonticium laxum (Miller) Ryv.; White rot of hardwoods and conifers; PIEN

Oidium candicans (Sacc.) Linder., anamorph of *Botryobasidium candicans* John Erikss.; White rot; POTR, QUGA

Peniophora cinerea (Pers.:Fr.) Cooke; White rot of dead conifers and hardwoods; ABLA 1, PIAR, PIEN, POTR, *Alnus*

Peniophora incarnata (Pers.:Fr.) Karst.; White rot of hardwoods; POTR

Peniophora nuda (Fr.) Bres.; White rot of dead hardwood branches and slash; QUGA

Peniophora polygonia (Pers.:Fr.) Bourd. et Galz.; White rot of dead aspen branches and slash; POTR

Peniophora pseudoversicolor Boid.; White rot of decorticated gambel oak slash and quite common on that substratum; QUGA

Peniophora rufa (Fr.) Boid.; White rot of dead aspen branches and slash and one of the major decay fungi on aspen; POTR

Peniophora septentrionalis Laurila; White rot of dead conifers; PIEN

Peniophora violaceo-livida (Sommerf.) Massee; White rot of hardwood slash; POTR, QUGA

Phanerochaete arizonica Burds. et Gilbn.; White rot of dead hardwood twigs and slash; QUGA

Phanerochaete avellanea (Bres.) John Erikss. et Hjortst.; White rot of dead hardwood twigs and slash; POAN, QUGA

Phanerochaete carnosa (Burt) Parm.; White rot of conifers and hardwoods; POTR, QUGA

Phanerochaete sanguinea (Fr.) Pouz.; White rot of hardwood and conifer slash; QUGA

Phanerochaete sordida (Karst.) John Erikss. et Ryv.; White rot of conifer and hardwood slash; POTR, QUGA, *Picea*

Phanerochaete tuberculata (Karst.) Parm.; White rot of hardwood slash; QUGA

Phanerochaete velutina (DC.:Fr.) Karst.; White rot of conifer and hardwood logs and slash; ABCO, PIEN, POTR, QUGA

Phlebia albida Post in Fr.; White rot of conifer and hardwood logs and slash; ABLA 1, PIEN, PIPO, PIPU, POTR, QUGA

Phlebia centrifuga Karst.; White rot of conifers; *Picea*

Phlebia lilascens (Bourd.) John Erikss. et Hjortst.; Rot not determined; QUGA

Phlebia livida (Pers.:Fr.) Bres.; White rot of conifer logs; Conifer

Phlebia radiata Fr.; White rot, usually on well-decayed wood; POTR

Phlebia subochracea (Bres.) John Erikss. et Ryv.; White rot; PIEN

Phlebia subserialis (Bourd. et Galz.) Donk; White rot of conifer logs; PIEN, PIPU

Phlebiella filicina (Bourd.) Larss. et Hjortst.; White rot; *Picea*

Phlebiella vaga (Fr.) Karst.; White rot of conifer and hardwood logs and slash; PIEN, PIPU, QUGA

Phlebiopsis gigantea (Fr.) Jülich; White rot of conifer and hardwood logs and slash; *Picea*

Phlebiopsis roumeguerii (Bres.) Jülich et Stalp.; White rot of conifers; PIEN

Piloderma bicolor (Pk.) Jülich; White rot of dead conifers; PICO, *Picea*

Piloderma byssinum (Karst.) Jülich; White rot of dead conifers and hardwoods; PICO, PIEN

Radulodon americanus Ryv.; White stringy rot of hardwoods; causes a heart rot in living aspen; POTR

Radulomyces confluens (Fr.) M.P. Chris.; White rot of hardwood slash; QUGA

Resinicium bicolor (Albl et Schw.:Fr.) Parm.; White rot of conifer slash; PICO

Resinicium chiricahuaense Gilbn. et Budingt.; White rot of conifers; ABCO, PSME

Resinicium furfuraceum (Bres.) Parm.; White rot of conifers; PIPO

Sistotrema brinkmannii (Bres.) John Erikss.; Brown rot of conifer and hardwood logs and slash; QUGA, *Picea*

Sistotrema coroniferum (Hoehn. et Litsch.) Donk; White rot of conifers and hardwoods; PIEN

Sistotrema diademiferum (Bourd. et Galz.) Donk; White rot; *Populus*

Sistotrema muscicola (Pers.) Lundell apud Lundell et Nannf.; Rot not determined; Conifer

Sistotrema raduloides (Karst.) Donk; White rot of aspen logs, occasionally on conifers; PIEN, POTR

Sphaerobasidium minutum (John Erikss.) Oberw.; Rot not determined; Conifer

Subulicystidium longisporum (Pat.) Parm.; White rot of hardwood slash; QUGA

Trechispora cohaerens (Schw.) Jülich et Stalp.; White rot of conifers and hardwoods; PIEN

Trechispora farinacea (Pers.:Fr.) Liberta; White rot of conifer and hardwood logs and slash; PIEN, PIPU, QUGA

Trechispora mollusca (Pers.:Fr.) Liberta; White rot of conifer and hardwood logs and slash; PIED

Tubulicrinis calothrix (Pat.) Donk; White rot of conifer and hardwood logs and slash; PICO, QUGA

Tubulicrinis effugiens (Bourd. et Galz.) Oberw.; White rot; POAN

Tubulicrinis glebulosa (Bres.) Donk; White rot of conifer slash; ABLA 1, PICO, PIED, PIPO, Juniperus
Tubulicrinis medius (Bourd. et Galz.) Oberw.; White rot; PIED, PIPO, QUGA
Tubulicrinis subulatus (Bourd. et Galz.) Donk; White rot of conifer slash; PIPU
Vesiculomyces citrinum (Pers.) Hagström; White rot of conifer and hardwood logs; ABLA 1, PIEN

Cyphellaceae

Cyphella fasciculata (Schw.) Berk. & Curt.; Rot not determined; dead wood
Cyphella villosa (Pers.:Fr.) Karst.; Rot not determined; Salix
Cyphellopsis anomala (Pers.:Fr.) Donk; White rot of hardwood logs and slash; ALTE, POTR, Salix
Cytidia salicina (Fr.:Fr.) Burt; Rot not determined; Salix
Henningsomyces candidus (Pers.) Kuntze; White rot of conifer and hardwood logs and slash; POTR
Solenia endophila (Ces.) Fr.; Rot not determined; POAN
Solenia polyporoidea Pk.; Rot not determined; Abies, Picea
Stromatoscypha fimbriata (Pers.:Fr.) Donk; White rot of dead conifers and hardwoods; Hardwood and conifer

Echinodontiaceae

Echinodontium tinctorium (Ell. et Ev.) Ell. et Ev.; White, stringy heart rot of living true firs; ABCO

Ganodermataceae

Ganoderma applanatum (Pers.) Pat.; White root and butt rot of living and dead hardwoods, esp. aspen; POAN, POTR, Betula

Hericiaceae

Hericium americanum Ginns; White rot; POTR
Mucronella aggregata Fr.; Rot not determined; PIEN

Hymenochaetaceae

Hymenochaete arida Karst.; White rot of hardwoods; ARTR, QUGA
Hymenochaete cinnamomea (Pers.) Bres.; White rot of hardwood slash, esp. oak; QUGA
Hymenochaete fuliginosa (Pers.) Bres.; White rot; PIEN
Hymenochaete rubiginosa Dicks. et Lév.; White rot of hardwoods; Quercus
Inonotus andersonii (Ell. et Ev.) Cerny; Parasitic white heart rot of trunks of living oaks; QUGA
Inonotus circinatus (Fr.) Gilbn.; White pocket rot of heartwood of roots and butt of living conifers; ABLA 1, PICO, PIEN
Inonotus dryadeus (Pers.:Fr.) Murr.; White rot of roots and butt of living conifers and hardwoods; PIEN
Inonotus dryophilus (Berk.) Murr.; White heart rot of trunks of living hardwoods, esp. oak; QUGA
Inonotus rheades (Pers.) Bond. et Sing.; White heartrot of living aspen; POTR

Inonotus subiculosus (Pk.) John Erikss. et Strid.; White rot of dead conifers; Conifer

Inonotus tomentosus (Fr.) Teng; White pocket rot of heartwood of roots and butt of living conifers; PICO, PIEN

Phellinus chrysoloma (Fr.) Donk; White pocket heartrot of trunks of living conifers, esp. spruce; CUSA, PIEN

Phellinus conchatus (Pers.:Fr.) Quél.; White rot of dead hardwoods; Hardwood

Phellinus ferreus (Pers.) Bourd. et Galz.; White rot of hardwood slash; ALTE

Phellinus ferrugineofuscus (Karst.) Bourd.; White rot of conifer logs and slash; ABLA 1, PIAR, PICO, PIEN

Phellinus ferruginosus (Schrad.:Fr.) Bourd. et Galz.; White rot of dead limbs and slash; ACGL, ACRU, QUGA

Phellinus hartigii (Allesch. et Schnabl) Bond.; White rot of living conifers, continuing in logs and slash; ABLA 1

Phellinus igniarius (L.:Fr.) Quél.; White heartrot of dead hardwoods; BEOC, Alnus

Phellinus nigrolimitatus (Rom.) Bourd. et Galz.; White pocket rot of conifer logs; ABLA 1, PICO, PIEN

Phellinus pini (Thore.:Fr.) A. Ames.; White pocket heartrot of living conifers; ABCO, ABLA 1, PICO, PIED, PIEN, PIFL, PIPO, PIPU, PSME

Phellinus pomaceus (Pers.:S.F. Gray) Maire; White heartrot of living fruit trees; PRAM

Phellinus punctatus (Fr.) Pilát.; White rot of dead hardwoods and conifers; Dead wood

Phellinus tremulae (Bond.) Bond. et Boriss.; White heartrot of living aspen; POTR

Phellinus viticola (Schw.:Fr.) Donk; White rot of dead conifers and hardwoods; PICO, PIEN

Lachnocladiaceae

Scytinostroma galactinum (Fr.) Donk; White rot of conifer slash; Conifer

Vararia granulosa (Fr.) Laurila; White rot of conifer logs; Conifer

Vararia investiens (Schw.) Karst.; White rot of conifer and hardwood logs; ABLA 1, PICO, PIEN, PIPU, POTR

Vararia racemosa (Burt) D.P. Rogers et Jacks.; White rot of conifer and hardwood logs and slash; ABLA 1, PIEN, POTR

Polyporaceae

Amylocystis lapponica (Rom.) Sing.; Brown rot of high elevation conifers; fruits under snow; PIEN

Anomoporia albolutescens (Rom.) Pouz.; Brown rot of conifers; ABLA 1, PICO, PIEN

Anomoporia bombycina (Fr.) Pouz.; Brown rot of conifers; PICO, PIEN

Anomoporia myceliosa (Pk.) Pouz.; White rot of conifers; PIPU

Antrodia albida (Fr.) Donk; Brown rot; Juniperus

Antrodia albobrunnea (Rom.) Ryv.; Brown cubical rot of conifers; PICO, Picea

Antrodia gossypina (Speg.) Ryv.; Brown rot of conifers; Conifer

Antrodia heteromorpha (Fr.) Donk; Brown cubical rot of conifers; PIEN

Antrodia juniperina (Murr.) Niem. et Ryv.; Brown cubical rot of Juniperus spp.; causes a heartrot of living trees; JUOS

Antrodia serialis (Fr.) Donk; Brown cubical rot of conifers and aspen; PICO, PIEN, PIPU, POTR, PSME

Antrodia sinuosa (Fr.) Karst.; Brown cubical rot of conifers; PIEN

Antrodia sitchensis (Baxt.) Gilbn. et Ryv.; Brown cubical rot of conifer logs; PIEN

Antrodia vaillantii (Fr.) Ryv.; Brown cubical rot of dead conifers and conifer wood in service; Fencepost, conifer

Antrodia variiformis (Pk.) Donk; Brown cubical rot of conifers and some hardwoods; PICO, PIEN, PIFL, *Betula*, *Quercus*

Antrodia xantha (Fr.) Ryv.; Brown cubical rot of conifers; PICO

Antrodiella romellii (Donk) Niem.; White rot of conifers; PIEN

Aporpium caryae (Schw.) Teix. et Rogers; White rot of hardwoods; Hardwood

Bjerkandera adusta (Willd.:Fr.) Karst.; White rot of hardwoods and occasionally conifers; common on aspen slash; POTR, *Pinus*

Byssoporia terrestre (DC.:Fr.) Lars. et Zak; Mycorrhizal on conifers; grows on very rotten wood; PICO, PIEN, *Populus*, *Quercus*

Ceriporia excelsa (Lund.) Parm.; White rot of hardwoods; QUGA

Ceriporia purpurea (Fr.) Donk; White rot of dead conifers and hardwoods; common on Gambel oak; QUGA, conifer

Ceriporia reticulata (Pers.:Fr.) Dom.; White rot of dead hardwoods and occasionally conifers; PIEN, POTR, QUGA

Ceriporia tarda (Berk.) Ginns; White rot of dead hardwoods and conifers; QUGA, *Juniperus*

Ceriporia viridans (Berk. et Br.) Donk; White rot of hardwoods; QUGA, *Populus*

Ceriporiopsis aneirina (Sommerf.:Fr.) Dom.; White rot of dead hardwoods; POTR

Ceriporiopsis mucida (Pers.:Fr.) Gilbn. et Ryv.; White rot of hardwoods and conifers; QUGA, conifer

Ceriporiopsis pannocincta (Rom.) Gilbn. & Ryv.; White rot of hardwoods; POTR

Ceriporiopsis subvermispora (Pilát) Gilbn. et Ryv.; White rot of hardwoods and conifers; PIEN

Cerrena unicolor (Bull.:Fr.) Murr.; White rot of hardwoods and occasionally conifers; PSME, hardwood

Climacocystis borealis (Fr.) Kotl. et Pouz.; White butt and root rot of living conifers and slash; PICO, PIEN, PIPU

Coriolopsis gallica (Fr.) Ryv.; White rot of hardwoods and rarely conifers; common on cottonwood slash; POAN, POTR, *Malus*, *Salix*

Cryptoporus volvatus (Pk.) Shear; White saprot of recently killed conifers; PICO, PIED, PIEN, PIPO, PSME

Daedaleopsis confragosa (Bolt.:Fr.) Schroet.; White rot of dead conifers and hardwoods; *Salix*

Datronia mollis (Sommerf.:Fr.) Donk; White rot of dead hardwoods and rarely conifers; ABLA 1, hardwood

Datronia stereoides (Fr.) Ryv.; White rot of dead hardwoods and rarely conifers; POTR, *Salix*

Dichomitus squalens (Karst.) D. Reid; White heartrot of living and dead conifers; ABLA, PICO, PIEN, PIPO

Diplomitoporus crustulinus (Bres.) Dom.; White rot of conifer slash; ABCO, ABLA 1, ABLA 2, PIEN

Diplomitoporus lenis (Karst.) Gilbn. et Ryv.; White rot of conifers and occasional hardwoods; ABLA 1, hardwood

Diplomitoporus lindbladii (Berk.) Gilbn. et Ryv. White rot of conifers and hardwoods; Conifer

Fomitopsis cajanderi (Karst.) Kotl. et Pouz.; Brown cubical rot of dead conifers and sometimes hardwoods; PIEN, POTR, PSME, Betula, Prunus
Fomitopsis officinalis (Vill.:Fr.) Bond. et Sing.; Brown heartrot of trunk of living conifers; PICO, PIPO, Picea
Fomitopsis pinicola (Swartz:Fr.) Karst.; Brown cubical rot of dead conifers and conifer slash and occasionally aspen; ABCO, PIEN, PIPO, PIPU, POTR, PSME, bridge planks
Fomitopsis rosea (Alb. et Schw.:Fr.) Karst.; Brown cubical rot of dead conifers and rarely hardwoods; causes a top rot in Douglas fir; ABCO, ABLA, PIEN, PIFL, PIPO, PIPU, PSME
Gloeophyllum odoratum (Fr.) Imaz.; Brown rot of conifers; PICO
Gloeophyllum protractum (Fr.) Imaz.; Brown rot of conifers; Conifer
Gloeophyllum sepiarium (Wulf.:Fr.) Karst.; Brown rot of conifers and hardwoods; one of the first invaders of conifer slash; PIED, PIEN, PIPO, POAN, POTR, PSME, QUGA
Gloeophyllum trabeum (Fr.) Murr.; Brown cubical rot of hardwoods, also some conifers; especially common on structural timbers; QUGA, conifer, & structural timbers
Gloeoporus dichrous (Fr.) Bres.; White rot of conifers and hardwoods; PICO, Populus
Gloeoporus taxicola (Pers.:Fr.) Gilbn. et Ryv.; White rot of conifers; PIEN, PIPO
Hapalopilus nidulans (Fr.) Karst.; White rot of hardwoods, more rarely conifers; QUGA, conifer
Heterobasidion annosum (Fr.) Bref.; Pathogenic white butt and root rot of living conifers; ABCO, PICO, coniferous mine timbers
Irpex lacteus (Fr.:Fr.) Fr.; White rot of dead hardwoods and rarely conifers; PILA
Ischnoderma resinosum (Fr.) Karst.; White rot of dead conifers and hardwoods; Conifer and hardwood
Jahnoporus hirtus (Quél. ex Cke.) Nuss.; White rot of living and dead conifers; Conifer
Junghuhnia collabens (Fr.) Ryv.; White rot of dead conifers, rarely hardwoods; Conifer
Junghuhnia luteoalba (Karst.) Ryv.; White rot of dead conifers; Conifer
Junghuhnia separabilima (Pouz.) Ryv.; White rot of dead hardwoods; Populus
Leptoporus mollis (Pers.:Fr.) Pilát; Brown cubical rot of dead conifers; ABCO
Oligoporus balsameus (Pk.) Gilbn. & Ryv.; Brown rot; ABLA 1, PIEN
Oligoporus caesius (Schrad.:Fr.) Gilbn. et Ryv.; Brown rot of conifer and hardwood logs and slash; PIEN, POTR
Oligoporus floriformis (Quél.) Gilbn. et Ryv.; Brown rot of dead hardwoods and conifers; Conifer
Oligoporus fragilis (Fr.) Gilbn. et Ryv.; Brown cubical rot of conifer logs; ABCO
Oligoporus leucomallellus (Murr.) Gilbn. et Ryv.; Brown cubical rot of conifer logs; PIEN
Oligoporus leucospongia (Cke. et Harkn.) Gilbn. et Ryv.; Brown rot of coniferous slash and rarely aspen; ABCO, PIEN, Pinus
Oligoporus obductus (Berk.) Gilbn. et Ryv.; Brown rot of conifer logs and stumps; PIEN
Oligoporus perdelicatus (Murr.) Gilbn. et Ryv.; Brown rot of conifer logs and slash; ABLA 1, PIEN, POTR
Oligoporus placentus (Fr.) Gilbn. et Ryv.; Brown cubical rot of conifer logs and slash; PICO, PIEN

Oligoporus rancidus (Bres.) Gilbn. et Ryv.; Brown rot of dead hardwoods and conifers; Hardwood, conifer

Oligoporus sericeomollis (Rom.) Pouz.; Brown cubical rot; PICO

Oligoporus stipticus (Pers.:Fr.) Gilbn. et Ryv.; PIPO

Oligoporus undosus (Pk.) Gilbn. et Ryv.; Brown cubical rot of dead conifers and hardwoods; Conifer

Oxyporus corticola (Fr.) Ryv.; White rot of dead conifer and hardwood logs and slash; GLTR

Oxyporus cuneatus (Murr.) Aoshima; White rot of western red cedar and bald cypress sapwood; Host not specified, but probably on wood in service (Overholts, 1953)

Oxyporus populinus (Schum.:Fr.) Donk; Acer

Oxyporus similis (Bres.) Ryv.; White rot of hardwood logs and slash, esp. Populus; POAN

Perenniporia ellisiana (F.W. Anderson) Gilbn. et Ryv.; White heartrot of living Shepherdia; SHAR

Perenniporia medulla-panis (Jacq.:Fr.) Donk; White rot of hardwood logs and slash; POTR, QUGA

Perenniporia subacida (Pk.) Donk; White stringy rot of conifer and hardwood logs and slash; ABLA 1, POTR, Picea

Perenniporia tenuis (Schw.) Ryv. var. **pulchella** (Schw.) Lowe; White rot of hardwood logs and slash, esp. aspen and oak; ARTR, POTR, QUGA, conifer

Perenniporia tenuis (Schw.) Ryv. var. **tenuis**; White rot of hardwood logs and slash; Hardwood

Phaeolus schweinitzii (Fr.) Pat.; Brown cubical rot of conifers, causing a root and butt rot of living trees; PICO, PIEN, PIPO, PSME

Polyporus alveolaris (DC.:Fr.) Bond. et Sing.; White rot of dead hardwoods; Hardwood

Polyporus arcularius Batsch:Fr.; White rot of hardwood logs and slash; QUGA

Polyporus badius (Pers.:S.F. Gray) Schw.; White rot of hardwood slash, rarely conifers; POTR, Alnus

Polyporus cryptopus Ell. et Barth.; Rot unknown; Dead grass roots

Polyporus elegans Bull.:Fr.; White rot of hardwood logs and slash; POTR, Alnus

Polyporus squamosus Huds.:Fr.; White rot of living hardwood and stumps; POTR

Polyporus varius Fr.; White rot of hardwood and conifer logs and slash; Populus

Pycnoporellus alboluteus (Ell. et Ev.) Kotl. et Pouz.; Brown cubical rot of conifer and hardwood logs and slash, fruiting under snow; ABMA, PIEN, POTR, Abies, Alnus

Pycnoporellus fulgens (Fr.) Donk.; Brown cubical rot of dead conifer and hardwood slash; Conifer

Pycnoporus cinnabarinus (Jacq.:Fr.) Karst.; White rot of hardwood slash and rarely conifers; PIED, PIPO, POAN, POTR, QUGA, Amelanchier, Betula

Pyrofomes demidoffii (Lév.) Kotl. et Pouz.; White heartrot of living junipers; JUMO, JUOS

Skeletocutis amorpha (Fr.) Kotl. et Pouz.; White rot of conifers; PIEN

Skeletocutis nivea (Jungh.) Keller; White rot of hardwood logs and slash; QUGA

Skeletocutis stellae (Pilát) Keller; White rot of conifer slash; PIEN

Skeletocutis subincarnata (Pk.) Keller; White rot of conifer slash; ABLA 1

Spongipellis spumeus (Sow.:Fr.) Pat.; White rot of dead and living hardwoods; Hardwood

Trametes cervina (Schw.) Bres.; White rot of hardwoods; POTR

Trametes hirsuta (Wulf.:Fr.) Pilát; White rot of hardwood logs and slash, rarely conifers; POAN, POTR

Trametes ochracea (Pers.) Gilbn. et Ryv.; White rot of dead hardwoods; POTR

Trametes pubescens (Schum.:Fr.) Pilát; White rot of hardwood logs and slash; Populus

Trametes trogii Berk. in Trog.; White rot of dead hardwoods; Hardwood

Trametes versicolor (L.:Fr.) Pilát; White rot of hardwood logs, stumps, and slash; POTR, QUGA

Trichaptum abietinum (Dicks.:Fr.) Ryv.; Common white pocket saprot of conifer logs and slash; ABCO, ABLA 1, PIED, PIEN, PIFL, PIPU, PSME

Trichaptum biforme (Fr. in Kl.) Ryv.; White pocket rot of hardwood logs and slash; POTR

Trichaptum laricinum (Karst.) Ryv.; White pocket rot of dead conifer sapwood; Conifer

Trichaptum subchartaceum (Murr.) Ryv.; White pocket rot of hardwoods, esp. aspen and cottonwood; POTR

Wrightoporia avellanea (Bres.) Pouz.; Brown rot, commonly on hardwoods; Conifer

Sparassidaceae

Sparassis crispa Fr.; Brown cubical butt and root rot of living conifers; PIPO

Steccherinaceae

Steccherinum ciliolatum (Berk. et Curt.) Gilbn. & Budingt.; White rot of conifer and hardwood logs and slash, esp. aspen; ABLA 1, PIEN, POTR

Steccherinum fimbriatum (Pers.:Fr.) John Erikss.; White rot of conifer and hardwood logs and slash; POTR, QUGA, Amelanchier, Picea

Steccherinum oreophilum Linds. et Gilbn.; White rot of aspen logs and slash; POTR

Stereaceae

Amylostereum chailletii (Pers.:Fr.) Boid.; White rot of conifer logs; ABLA 1, PIEN

Chaetoderma luna (Rom.:Rogers et Jacks.) Parm.; Brown cubical rot of dead conifers; ABLA 1, PICO, PIEN, PIPO

Columnocystis abietina (Pers.:Fr.) Pouz.; Brown cubical rot of conifer logs at high elevation; ABLA 1, PIEN, PSME

Haematostereum sanguinolentum (Alb. et Schw.:Fr.) Pouz.; White rot of conifer logs; ABLA 1, PICO, PIEN

Laurilia sulcata (Burt) Pouz.; White rot of high elevation conifer logs; ABLA, PIEN, PIPU

Stereum hirsutum (Willd.:Fr.) S.F. Gray; White rot of dead hardwoods; ALTE, BEOC, QUGA

Stereum ochraceo-flavum (Schw.) Ellis; White rot of dead hardwoods, but only reported on conifer in Colorado; PIEN

Stereum ostrea (Blume et Nees:Fr.) Fr.; White rot of dead hardwoods; Alnus, Betula, Populus

Stereum rugisporum (Ell. et Ev.) Burt; Brown rot of conifers; PICO, PIEN, Abies

Thelephoraceae

Pseudotomentella nigra (Hoehn. et Litsch.) Svrcek; Rot not determined; Picea
Pseudotomentella tristis (Karst.) M.J. Larsen; Rot not determined; QUGA, Populus
Thelephora terrestris Ehr.:Fr.; Rot not determined; QUGA, sawdust
Tomentella brevispina (Bourd. et Galz.) M.J. Larsen; Rot not determined; Populus
Tomentella calcicola (Bourd. et Galz.) M.J. Larsen; Rot not determined; POTR
Tomentella coerulea (Bres.) Hoehn. et Litsch.; Rot not determined; POTR
Tomentella ferruginea (Pers.) Pat.; Rot not determined; QUGA, Populus
Tomentella fuliginea (Burt) Bourd. et Galz.; Rot not determined; POTR
Tomentella lateritia Pat.; Rot not determined; POTR, Picea
Tomentella molybdaea Bourd. et Galz.; Rot not determined; QUGA
Tomentella pilosa (Burt) Bourd. et Galz.; Rot not determined; QUGA
Tomentella ramossissima (Berk. et Curt.) Wakef.; Rot not determined; POTR, QUGA
Tomentella subtestacea Bourd. et Galz.; Rot not determined; QUGA
Tomentellastrum brunneofirmum (M.J. Larsen) M.J. Larsen; Rot not determined; POTR
Tomentellastrum floridanum (Ell. et Ev.) M.J. Larsen; Rot not determined; POTR
Tomentellina fibrosa (Berk. et Curt.) M.J. Larsen; Rot not determined; PIPO, POTR
Tomentellopsis bresadoliana (Sacc. et Trotter) Jülich et Stalp.; Rot not determined; PIPO

Dacrymycetales

Dacrymyces abietinus (Pers.) Schroet.; Brown rot; PIEN
Dacrymyces minor Pk.; Brown rot; QUGA
Heterotextus alpinus (Tracy et Earle) G.W. Martin; Brown rot; fruits under snow at high elevations on conifer logs and slash; PIEN

Tulasnellales

Tulasnella violea (Quél.) Bourd. et Galz.; Rot not determined; PIPU

HYMENOMYCETES: PHRAGMOBASIDIOMYCETIDAE

Auriculariales

Auricularia auricularis (S.F. Gray) G.W. Martin; White rot of conifer logs and slash; ABCO, ABLA 2, Picea
Helicobasidium corticioides Bandoni; Brown cubical rot of high elevation conifer logs and slash; ABLA 2, PIEN
Platygloea laplata Linds.; Rot not determined; QUGA

Tremellales

Bourdotia eyrei (Wakef.) Bourd. et Galz.; White rot; PIPU
Exidia glandulosa Fr.; White rot of dead hardwood limbs and slash; QUGA
Pseudohydnum gelatinosum (Fr.) Karst.; Rot not determined; PIEN

ACKNOWLEDGEMENTS

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MYCOTAXON

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NEW XANTHOPARMELIA (LICHENIZED ASCOMYCOTINA) FROM BRAZIL

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Abstract: A new species, *Xanthoparmelia oblisata*, is described from the state of Sao Paulo, Brazil.

Xanthoparmelia oblisata Fletcher & Hale sp. nov. Fig. 1

Thallus proxime appressus saxo siliceo, 2–3 cm diametro. Lobi 0.4–0.8 mm lati, contigui, incomposite dichotomi, axillis acutissimis, radiati, non imbricati. Cortex superior nitidus, flavo-viridis, paulum convexus, margine fuscus in apicibus, canus in partibus vetioribus. Cortex inferior medius fuscus in centro, obscurans ad apices, rhizinis validis, sparsis brevibusque, inramosis, fusco-nigris. Medulla alba, K+ flavo-rubra, Pd+lutea. Apothecia absentia. Thallus acidum usnicum, acidum sticticum atque acidum consticticum continens.

Holotype: Brazil, Rio de Janeiro, Monte Agulhas Negras, Plateau de Retiro, 22° 25'S 44° 40'W, on open exposed rocks on treeless plateau, altitude 1500 m. Collector *A.Fletcher*, 10104, 22nd April 1975, LTR: B15.1985.1177 (isotype in US).

Thallus tightly adnate on siliceous rock 2–3 cm broad, yellowish green but soon darkening toward the center, becoming grey in older parts. *Lobes* sublinear, radiating, 0.4–0.8 mm wide, relatively short, slightly convex, and dichotomously branched, brown-rimmed at the tips, the axils strongly acute, contiguous to subimbricate sparingly short-laciniate, the lacinae 0.1–0.2 mm wide, subascending. *Upper surface* continuous, shiny, transversely cracked and rugulose with age, soredia and isidia lacking. *Lower surface* plane, shiny, brown to dark brown, darkening towards tips, but not blackening, moderately rhizinate, rhizines brown, short, robust, 0.1–0.3 mm long, unbranched. *Pycnidia* numerous; conidia bifusiform, 0.5×4–6 μm long. Medulla white, K+yellow-red, Pd+yellow-orange. *Apothecia* lacking.

Chemistry TLC: Usnic, stictic, and constictic acids; no trace of norstictic acid.

Additional specimens: Brazil, details as holotype, (LTR: B15.1985.1170). Brazil, Sao Paulo, 200km N.W. of Sao Paulo, just S. of Campo Alegre, 47 55 W 22 20 S, on rocks on east facing high cliffs above the road, in dense cerrado, Collectors *A.Fletcher* and *M.P.Marcelli*, 28th February 1978. (LTR: B18.1985.569)

Both known localities are at moderate elevation (1500 m), on dry, well lit rocks in fire-prone cerrado. This species is a member of the *X. cumberlandia* (Gyel.) Hale group and is almost certainly the parent morph of the isidiate *X. neopropagulifera* (Gyel.) Hale. It is distinguished by the tight adnation and very narrow lobes. It is related to *X. convexula* (Müll. Arg.) Hale from Socotra and East Africa, which has short subirregular lobes.

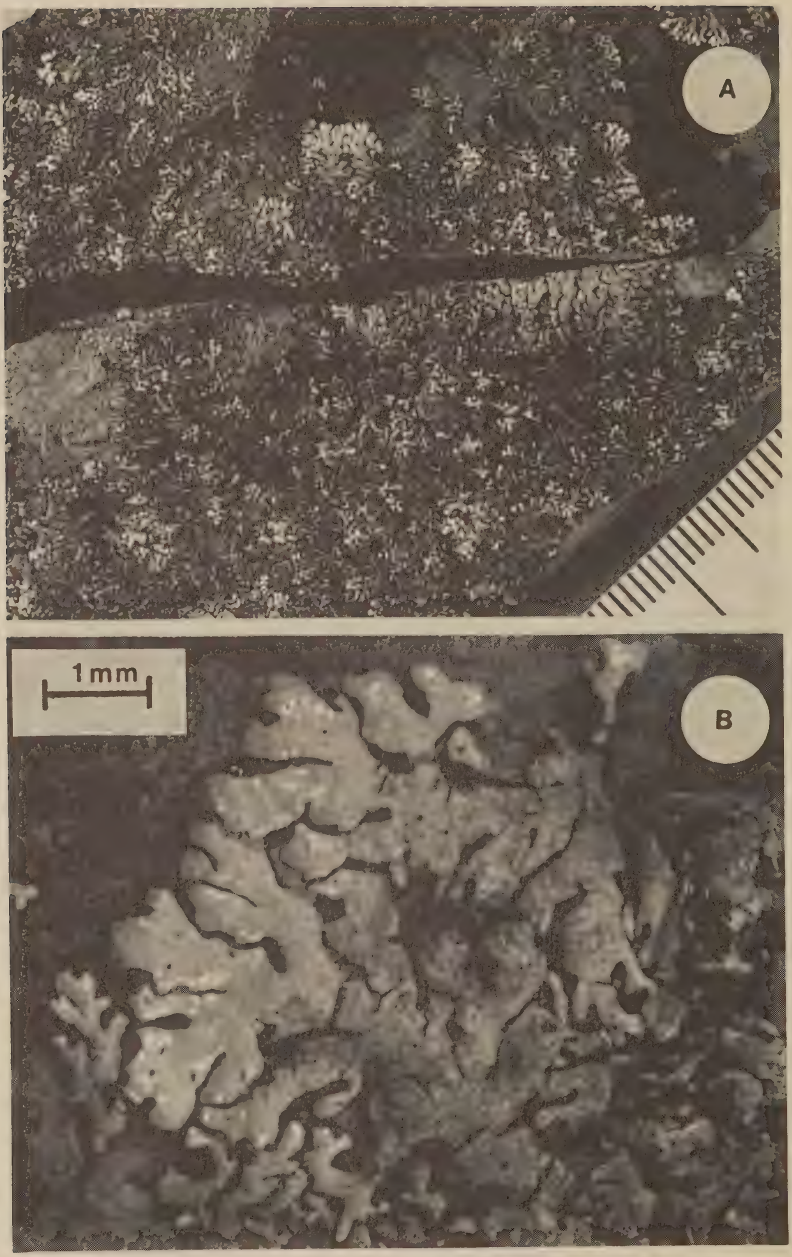

Figure 1 A,B. Holotype of *Xanthoparmelia oblisata*. Scale in mm.

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ARE THERE THECAPHORA SPECIES (USTILAGINALES) ON GRAMINEAE? *

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ABSTRACT

None of the five described Thecaphora species on Gramineae belong to this genus. Four of the five are not smut fungi. The last species, Thecaphora herteriana Cif., on Melica hyalina Doell, turned out to be a Urocystis (Ustilaginales), for which we are proposing the new combination Urocystis herteriana (Cif.) Berbee, and selecting a lectotype. This species differs from all three previously described Urocystis (Tuburcinia) species on Melica, including Tuburcinia mussati Massenot, which is considered to be synonym of U. melicae.

The species of the genus Thecaphora Fingerhuth (Ustilaginales) are characterized by spores agglomerated in loose to permanent spore balls, produced in various parts of the host plants. There are approximately 45 accepted species of Thecaphora, parasitizing species of 17 host families. Of the host families 13 are dicots and 4 are monocots. The four monocot families are: Cyperaceae (with 6 known Thecaphora species), Liliaceae (with 2 species), Restionaceae (1 species), and Gramineae (with 5 described Thecaphora species). All Thecaphora species from monocots produce a black spore mass, whereas the Thecaphora species on dicots produce a brown spore mass. We question whether the species on monocots properly belong to the genus Thecaphora. Some "Thecaphora" species on monocots have already been transferred into the genus Tolyposporium /e.g. Tolyposporium aterrimum (L.-R. & C. Tul.) Dietel/, but more studies, including studies on spore ball ontogeny and spore germination, are needed to elucidate the correct place for these species. Four of the five Thecaphora species from Gramineae were demonstrably not smut fungi. For example T. ammophilae Oud., on Ammophila arenaria (L.) Link, is a Stemphylium sp. (Liro 1938:324); T. andropogonis Speg., on Andropogon sp., is a Cladosporium-like fungus (Zundel 1953:117); T. berkeleyana Fischer v. Waldh., on Andropogon perforatus Trin. ex Fourn., is Cerebella andropogonis Ces. (Zundel 1953:117); T. westendorpii Fischer v. Waldh., on Lolium perenne L. is a hyphomycete (Liro 1938:323). The remaining grass-parasitizing species, Thecaphora herteriana Cif. was therefore suspect and the study of the types showed that it is actually a Urocystis species. Ciferri (in Ciferri & Herter 1932:536) described it from two Melica hyalina Doell collections from Uruguay, both collected by W.G. Herter. Of the two syntypes one is very poor (Dept. Montevideo, Atahualpa, XI.1925, W.G. Herter 79865; BPI 179242). The second syntype, which is selected here as lectotype, contains a

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* Studies in Heterobasidiomycetes, part 52.

few infected plants. This fungus destroys the whole inflorescence of Melica hyalina. Infected inflorescences are hidden by leaf sheaths. The sori are at first covered by a thin, grayish membrane which ruptures irregularly disclosing the black, granular-dusty mass of spore balls. Spore balls are ovoid, ellipsoidal, or irregular, rarely subglobose, 21–36 x 20–40(–48) µm, dark reddish-brown, composed of 1–6(–8) spores completely surrounded by sterile cells of the same color. Spores polyangularly subglobose, ellipsoidal to slightly irregular, 9.5–12 x (10.5–)12–16(–17) µm. Sterile cells collapsed with age, 8–20 µm long, relatively thick-walled (1–3 µm). The dark sterile cells were apparently mistaken by Ciferri for spores, hence the wrong generic placement. The structure of the spore balls became evident especially after bleaching them with a 20% solution of H_2O_2 for c. 15 minutes.

In conclusion, we propose the following new combination: Urocystis herteriana (Ciferri) Berbee, comb. nov. Basionym: Thecaphora herteriana Ciferri, in Ciferri & Herter, Botanisches Archiv 34:536, 1932. Lectotype on Melica hyalina Doell, Uruguay, Dept. Montevideo, Cerro, XI.1924, coll. W.G. Herter (76151; Herb. Ciferri in BPI 179243!).

Three other smuts belonging to the genus Urocystis Rbh. ex Fuckel (= Tuburcinia Fr.) were described from different Melica species:

1) Urocystis bornmuelleri P. Magnus (1912:290), on Melica cupanii Guss., Syria.
2) Urocystis melicae (Lgh. & Liro) Zundel (1953:326); syn. Tuburcinia melicae Lgh. & Liro, in Liro (1922:23), on Melica nutans L., Norway.
3) Tuburcinia mussati Massenot (1955:181), on Melica nebrodensis Parl. (= M. ciliata L. subsp. ciliata), France. This last species is identical to the type of, and therefore considered synonymous with, U. melicae.

The main differences between the three species of Urocystis on Melica spp., are presented in form of a key.

1. Sori destroying the whole inflorescence. Spores and sterile cells dark reddish-brown . . . . U. herteriana
1. Sori in leaves or ovaries, sterile cells lighter than the spores 2
   2. Sori in leaves as striae and in the ovaries. Spore balls composed of 1–5(–more) spores. Spores averaging 18 µm long . . . . . U. bornmuelleri
   2. Sori restricted to the leaves forming striae. Spore balls composed of 1–3(–5) spores. Spores averaging 15 µm long . . . . U. melicae

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A NEW SPECIES OF ARTHRODERMA FROM JAPANESE SOIL

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SUMMARY

Arthroderma crocatum Udagawa, Kubo et Shibaki, a new species, is described and illustrated from an isolate from soil, in Hokkaido, Japan. The fungus is homothallic and characterized by small ascospores and restricted growth on PYE agar. A *Chrysosporium* anamorph is associated.

During the past several years, about 1000 soil samples from various areas in Hokkaido, northern Japan, have been screened for Arthrodermataceae and other keratinophilic fungi. As teleomorphic isolates, 90 strains of *Arthroderma uncinatum* Dawson et Gentles, 13 of *A. cajetani* (Ajello) Ajello, Weitzman, McGinnis et Padhye, 3 of *A. insingulare* Padhye et Carmichael, and one strain each of *A. quadrifidum* Dawson et Gentles, *A. otae* (Hasegawa et Usui) McGinnis, Weitzman, Padhye et Ajello and *Ctenomyces serratus* Eidam were obtained by Vanbreuseghem's hair-bait technique (Kubo, 1986). Of particular interest was the additional isolation of *A. otae* , since this species was first recorded from Japanese soil.

In the course of further trials to isolate *A. otae* from 246 soils from the related locations, a homothallic isolate of *Arthroderma* was encountered. It is considered to be sufficiently different from all described species of *Arthroderma* (Padhye and Carmichael, 1971; Currah, 1985) to warrant its description as a new species.

Arthroderma crocatum Udagawa, Kubo et Shibaki, sp.nov. (Figs. 1-6)

St. anam. *Chrysosporium.*

Coloniae in agaro "modified Sabouraud" tarde crescentes, post 14 dies sub 25°C 28-31 mm diametro, planae, tenues, initio floccosae et albae, deinde granulares et luteolae; reversum flavescens vel sulphureum. Ad 37°C non crescit.

Fungus homothallicus. Ascomata superficialia, discreta vel minute confluentia, bubalina, globosa vel subglobosa, appendiculis exclusis 280-360 µm diam. Hyphae peridii hyalinae vel dilute flavo-brunneae, septatae, saepe uncinatim ramosae; cellulae interiores cylindraceae, 22-55 x 3.5-4.5 µm, leves vel asperatae; cellulae exteriores biscoctiformes, aequaliter vel inaequaliter constrictae, asperulatae, 4-10 x 4-9 µm, in parte media constrictae (3-5 µm diam). Appendiculae hyalinae, leves, tenues, 2.5-3 µm diam, in 4-5 spiras convolutae, terminales. Asci unitunicati, 8-spori, hyalini, globosi vel subglobosi vel ovoidei, 4.5-5.5 x 4-4.5 µm, evanescentes. Ascosporae hyalinae, deinde leviter flavescentes, oblatae, 1.5-2 x 1-1.5 µm, leves.

Mycelium ex hyphis hyalinis, ramosis, septatis, levibus, saepe anastomosantibus, 1-3.5 µm diam compositum. Hyphae septum versus inflatae adsunt. Conidia terminalia et lateralia, sessilia vel brevipedicellata, vulgo unicellularia, hyalina, obovoidea ad clavata, 3-6(-8) x 1.5-3.5 µm, apice rotundata, basi truncata, levia vel asperulata. Chlamydosporae terminales vel intercalares, hyalinae, globosae vel subglobosae, 5-10 µm diam, leves et incrassatae.

Holotypus: colonia exsiccata, ex solo, Nakagawa-cho, Nakagawa-gun, Hokkaido, in Japonia, 6.v.1986, a H. Kubo, isolata, NHL 2986. In collectione fungorum "National Institute of Hygienic Sciences (NHL), Tokyo, Japan."

Etymology: Latin, *crocatus* =saffron-yellow-colored, referring to the colony color on oatmeal agar.

Colonies on modified Sabouraud's agar (Takashio, 1972) growing restrictedly, attaining a diameter of 28-31 mm in 14 days at 25°C, plane, thin, vegetative mycelium submerged, floccose, with surface growth becoming granular in appearance due to the development of abundant ascomata, initially white, becoming light yellow (M.4A4, after Kornerup and Wanscher, 1978) or "Pale Luteous" (Rayner, 1970); reverse yellow (M.1A3) or "Sulphur Yellow" (Rayner).

Homothallic. Ascomata superficial, discrete or confluent in small groups, buff, globose to subglobose, 280-360 µm diam excl. appendages, composed of a central mass of

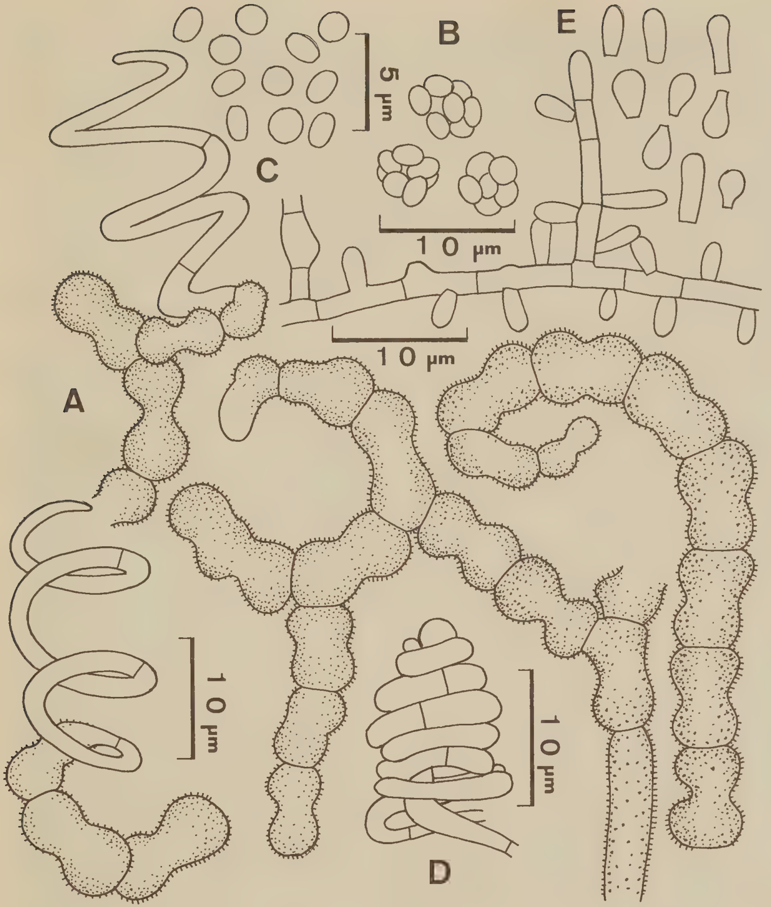


Fig. 1. *Arthroderma crocatum,* NHL 2986.
A. Peridial hyphae. B. Asci. C. Ascospores.
D. Ascomatal initial. E. Conidiogenous cells and conidia.

asci surrounded by a network of branched, anastomosed hyphae. Peridial hyphae hyaline to pale yellowish brown, septate, often uncinately branched; inner cells of the peridial hyphae cylindric, 22-55 x 3.5-4.5 µm, smooth or rough-walled; outer cells of the peridial hyphae dumbbell-shaped, symmetrically or asymmetrically constricted, asperulate, 4-10 x 4-9 µm, 3-5 µm diam at narrow waist, infrequently terminating in a spiral appendage; appendages hyaline, smooth, thin-walled, 2.5-3 µm diam, helical with 4-5 turns measuring 13-18 µm diam. Asci unitunicate, 8-spored, hyaline, globose to subglobose or ovoid, 4.5-5.5 x 4-4.5 µm, evanescent. Ascospores initially hyaline, later becoming pale yellow, oblate, 1.5-2 x 1-1.5 µm, smooth.

Mycelium composed of hyaline, branched, septate, smooth, often anastomosed, 1-3.5 µm diam hyphae. Racquet hyphae present, swollen up to 5-7 µm diam near the septum. Ascomatal initials composed of a clavate antheridium surrounded by a coiled ascogonium. Terminal and lateral conidia abundantly produced on undifferentiated hyphae, sessile or short-pedicellate, mostly one-celled, hyaline, obovoid to clavate, 3-6(-8) x 1.5-3.5 µm, rounded above, truncate at base, smooth or rough-walled with small points. Chlamydospores terminal or intercalary, hyaline, globose to subglobose, 5-10 µm diam, smooth and thick-walled.

Colonies on PYE agar growing slowly, attaining a diameter of 27-29 mm in 14 days at 25°C, plane, composed of a compact basal felt with aerial growth appearing floccose, white to pale yellow (M.2A3) or "Straw"(Rayner); ascomata not produced; reverse reddish yellow (M.4A6) to deep orange (M.5A8) or "Luteous" (Rayner).

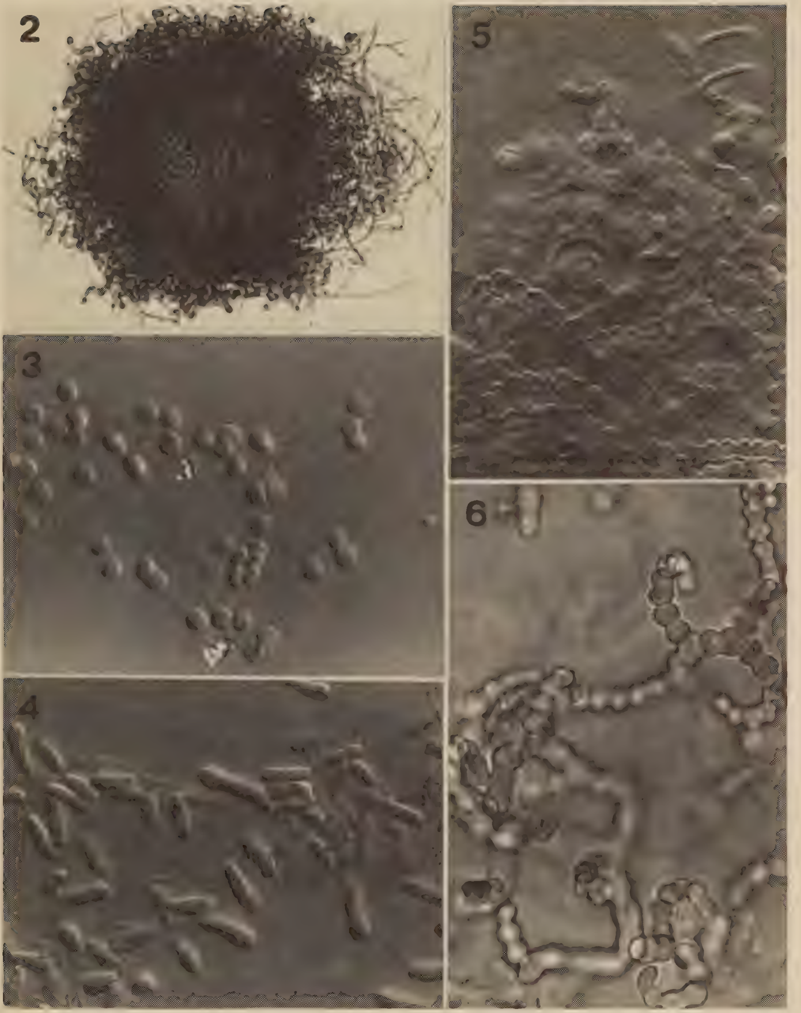
Colonies on oatmeal agar growing more rapidly, up to 33-35 mm in 14 days at 25°C, in texture as on modified Sabouraud, light orange (M.5A4) or "Saffron" (Rayner); reverse pale yellow (M.4A3) or "Buff" (Rayner).

At 37°C, growth is nil.

Keratinolytic, but pathogenicity has not been demonstrated.

Isolation: soil, Nakagawa-cho, Nakagawa-gun, Hokkaido, Japan, 6.v.1986, coll. H. Kubo, NHL 2986 (Holotype). An isolate derived from the holotype of *A. crocatum* was sent for deposit to the Microfungus Collection and Herbarium, Devonian Botanic Garden, University of Alberta, Edmonton, Canada (UAMH).

According to the key proposed by Padhye and Carmichael (1971) for members of the genus *Arthroderma* , *A. crocatum* may be included in the *A. curreyi* group with those species producing small-sized microconidia only (mostly less than 4 µm diam). In this group, there are two homothallic species, viz. *A. curreyi* Berk. and *A. ciferrii* Varsavsky et Ajello, and a heterothallic one, *A. cuniculi* Dawson. The microconidia of these three species



Figs. 2-6. *Arthroderma crocatum,* NHL 2986. 2. Ascoma. x100. 3. Ascospores. x1500. 4. Conidiogenous cells and conidia. x1200. 5. Peridial hyphae with spiral appendages. x600. 6. Uncinately branched peridial hyphae. x600.

are recognized as individual anamorph species in the form-genus *Chrysosporium* (van Oorschot, 1980), but vary little from species to species, the slight differences being in shape and roughness. In another group having microconidia only, the distinctive *Chrysosporium* anamorph of *A. tuberculatum* Kuehn was considered later to be a species of *Myceliophthora* by van Oorschot (1980). All the remaining species of *Arthroderma* have macroconidia that belong to the form-genus *Trichophyton* (Padhye and Carmichael, 1971; Currah, 1985). In contrast to *A. curreyi* and *A. ciferrii* in the *A. curreyi* group, all the remaining species are heterothallic and the gymnothecia (ascomata) are produced only after crossing compatible mating types. The production of fertile gymnothecia by all single ascospore isolates indicates that *A. crocatum* is homothallic. Thus *A. crocatum* is closely related to *A. curreyi* and *A. ciferrii* in being homothallic, and in having a *Chrysosporium* anamorph. The gymnothecia, asci and ascospores of the known species of *Arthroderma* are so similar that the morphology of their gymnothecia is not always of much help in differentiating the species. The ascospores of *A. crocatum* are circular in face view, and elliptical in side view. This ascospore shape is certainly typical of the genus. Padhye and Carmichael (1971) used the term "oblate sphaeroids" to describe ascospores with this shape. The most significant difference between *A. crocatum* and the species, *A. curreyi* and *A. ciferrii* , is that the ascospores of *A. crocatum* are significantly smaller. The ascospores of *A. crocatum* are 1.5-2 x 1-1.5 µm, while those of *A. curreyi* and *A. ciferrii* are 2.5-3.5 x 1.5-2.5 µm and 2.5-3.5 x 1.5-2.8 µm respectively. *Arthroderma crocatum* is also readily distinguished from *A. curreyi* by its more restricted growth on PYE agar. In the growth-rate, another related species, *A. ciferrii* , rather resembles *A. crocatum* but differs in producing colonies marked by a rich vinaceous red to brown pigmentation in reverse (The examination of authentic cultures (UAMH 2534 and 3430) of this species well revealed a vinaceous red pigmentation).

Nannizzia Stockdale (1961) is distinguished from *Arthroderma* by both the verticillately branched peridial hyphae with moderately constricted cells and rough-walled *Microsporum* conidia. Peridial hyphae in *A. crocatum* are characterized by formation of cylindric, smooth or rough-walled inner cells, and dumbbell-shaped outer cells lacking knobby protuberances. These characters of the peridial hyphae are somewhat suggestive of a transitional form in the direction of *Nannizzia*. Recently, based upon a re-evaluation of the morphological characters used to define the genera *Arthroderma* and *Nannizzia* , Weitzman et al. (1986) determined that these two genera are not clearly separable and the differences between the two are only sufficient at the species level. Thus 12 species of *Nannizzia* are now considered as species of *Arthroderma* under their new concept. All *Nannizzia* species are heterothallic and generally known from laboratory culture where they can be induced by appropriate matings of conidial isolates, while *A. crocatum* is proven to be homothallic.

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MYCOTAXON

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EMERICELLOPSIS SPHAEROSPORA AND KERNIA PERUVIANA, TWO NEW SOIL-BORNE CLEISTOTHECIAL ASCOMYCETES

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SUMMARY

Two new species of cleistothecial Ascomycetes are described and illustrated: *Emericellopsis sphaerospora* Udagawa et Furuya (anam. *Acremonium*) from Japanese soil and *Kernia peruviana* Udagawa et Furuya (anam. *Scopulariopsis*) from Peruvian soil. The addition of urea to soil samples allowed the appearance and isolation of both species.

It is clear that urea changes the pattern of fungal colonization from that found during decomposition of litter (Sagara and Hamada, 1965; Sagara, 1975; Lehmann, 1976). For example, after application of urea to litter of a mixed coniferous forest in Japan, fruit-bodies of *Amblyosporium botrytis* Fres., *Ascobolus denudatus* Fr., *Coprinus cinereus* (Schaeff.: Fr.) S.F. Gray, *C. phlyctidosporus* Romagn., *Hebeloma spoliatum* (Fr.) Karst., *H. vinosophyllum* Hongo, *Hebeloma* sp., *Lyophyllum tylicolor* (Fr.: Fr.) M. Lange et Sievertsen, *Peziza moravecii* (Svrcek) Donadini and *Pseudombrophila deerata* (Karst.) Seaver appeared, all of which were not found on untreated litter. This ecological group of urea-responding fungi is often referred to as "ammonia fungi" (Sagara, 1975). Sagara (1976) also showed that buried mammalian carcasses have been occasionally found below the sporophores of an ammonia fungus *Hebeloma vinosophyllum*.

Relatively little attention, however, has been paid to the appearance of ascomycetous microfungi as urea-responders. Horie and Udagawa (1983) reported that several members of the ascomycetous family Microascaceae have been recorded from litter treated with urea and two such unusual urea-responders, *Microascus tardifaciens* Horie et Udagawa and *Petriella proteophila* Horie et Udagawa, were described as new taxa in the family. A rather similar finding has been obtained with the isolation of *Microascus caviariformis* Malloch et Hubart from decaying meat in the Cave of Ramioul, Belgium (Malloch and Hubart, 1987). The occurrence of *M. caviariformis* on meat left in the cave and its good performance on proteinaceous culture media suggested that it may be associated with carcasses of animals in the cave.

During a study of fungal succession on urea treated soil, two cleistothecial Ascomycetes were isolated which could not be assigned to any known taxa. Urea treatment apparently stimulated the development of fruit-bodies of both species on soil, because oatmeal medium with urea (containing (g/l): oatmeal, 10; $NaNO_3$, 1; KH_2PO_4, 1; $MgSO_4 \cdot 7H_2O$, 1; urea, 2; agar, 20) allowed the fastest growth and abundant teleomorph production. Descriptions of the species are presented in this paper.

Emericellopsis sphaerospora Udagawa et Furuya, sp.nov. (Figs. 1, 3-7)

St. anam. *Acremonium*.

Ascomata superficialia vel immersa, dispersa, fuscobrunnea vel nigra, globosa vel subglobosa, 90-200 µm diam, non ostiolata, glabra vel pauci-pilosa; peridium 8-12 µm crassum, fuscobrunneum, membranaceum, "textura angularis", e stratis duobus vel tribus compositum. Asci irregulariter dispersi, octospori, globosi vel subglobosi vel ovoidei, 11-14 x 9-12 µm, valde evanescentes. Ascosporae unicellulares, hyalinae vel dilute flavo-brunneae, globosae vel subglobosae, sine cristis 6-7 µm diam, e spinis costisque brevibus et 2-4 cristis aliformibus ornatae.

Mycelium e hyphis hyalinis, ramosis, septatis, 1-3 µm diam, levibus, saepe fasciculatis compositum. Conidiophora semimacronemata vel micronemata, mononemata, brevissima, hyalina, levia, simplicia, septata. Cellulae conidiogenae monophialidicae, simplices, discretae, subulatae, 16-32 x 2-3 µm, leves. Conidia hyalina, ellipsoidea vel cylindrica vel allantoidea, 3-8 x 1.5-3 µm, aseptata, utrinque rotundata, levia, in capitulis mucidis connexa.

Holotypus: NHL 2984, colonia exsiccata, isolatus e solo virgulto, Narita-shi, Chiba, in Japonia, 20.ix.1987, legit. K. Furuya. In Herbario NHL. Isotypus: SANK.

Etymology: Latin, *sphaero-* =globose and *spora* =seed,

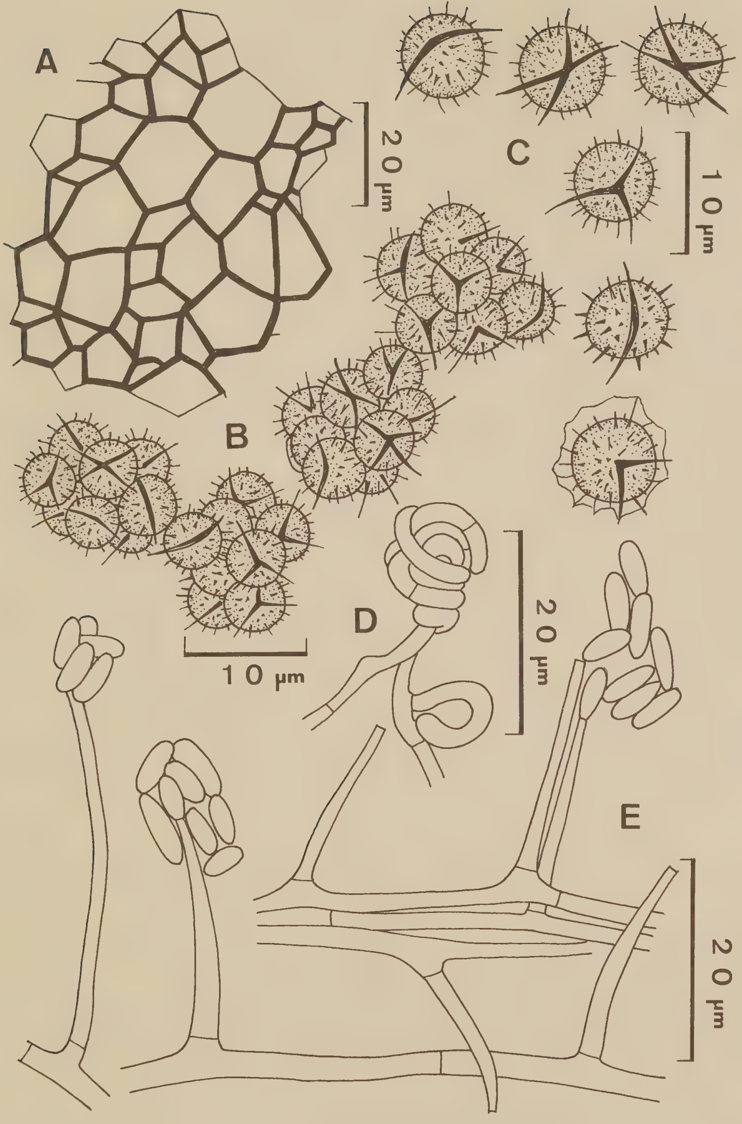

A
20 µm
C
10 µm
B
10 µm
D
20 µm
E
20 µm

Fig. 1. *Emericellopsis sphaerospora* , NHL 2984.
A. A portion of peridium. B. Asci. C. Ascospores.
D. Ascomatal initial. E. Conidiogenous cells and conidia.

referring to the shape of ascospores.

Ascomata arising from a coiled initial of two hyphae, superficial or immersed, scattered, dark brown to black, shin by reflected light, opaque, globose to subglobose, 90-200 µm diam, non-ostiolate, glabrous or covered with a few, hyaline, short, septate, 2-4 µm diam, hypha-like hairs; peridium 8-12 µm thick, dark brown, membranaceous, composed of textura angularis, 2-3-layered; the outer layer consisting of brown, fairly thick-walled, angular cells measuring 5-22 x 4-18 µm and the inner layer of hyaline, very thin, flattened cells measuring 15-28 µm diam. Asci irregularly disposed, 8-spored, globose or subglobose to ovoid, 11-14 x 9-12 µm, very evanescent. Ascospores one-celled, hyaline to pale yellowish brown, globose to subglobose, 6-7 µm diam excluding ridges, longitudinally ornamented by 2-4 wing-like ridges projecting 2-3(-4) µm wide, stellate in section, in convex surfaces roughened by spines and small ridges.

Mycelium composed of hyaline, branched, septate, 1-3 µm diam, smooth-walled hyphae, often aggregated in a bundle. Conidiophores mononematous, not distinct from the hyphae of aerial mycelium, very short, hyaline, smooth-walled, unbranched, septate, ending in a monophialidic conidiogenous cell. Conidiogenous cells borne on the conidiophore or directly from the hyphae of vegetative mycelium and the strands of aerial mycelium, hyaline, simple, discrete, awl-shaped, 16-32 x 2-3 µm, smooth-walled, with no distinct collarette. Conidia hyaline, ellipsoid to cylindrical or allantoid, 3-8 x 1.5-3 µm, aseptate, with rounded ends, smooth-walled, aggregating in slimy heads.

Colonies on oatmeal agar with 2 per cent urea spreading broadly, attaining a diameter of 55-60 mm in 2 weeks at 23°C, thin, vegetative mycelium submerged, more or less moist, initially white, later becoming grayish brown (M. 8F3, after Kornerup and Wanscher, 1978) or "Dark Mouse Grey" to "Fuscous Black" (Rayner, 1970) with the development of abundant ascomata, aerial hyphae and conidia sparsely produced, not affecting the colony appearance; reverse uncolored to grayish orange (M. 5B3) or "Buff" (Rayner).

At 37°C, growth is more rapid, and ascomata and conidia are abundantly formed.

Specimen examined: a dried colony isolated from copse soil, Sanrizuka, Narita-shi, Chiba-pref., Japan, Sept. 20, 1987, coll. K. Furuya, NHL 2984, holotype.

Subculture derived from the holotype has been deposited with Fermentation Research Laboratories, Sankyo Co., Ltd., Tokyo (SANK).

The particularly distinctive characteristics of *E. sphaerospora* are globose ascospores, which are ornamented with spines, short ridges and longitudinal wing-like ridges. This type of ornamentation reminds one of *Eleutherascus peruvianus* Huang (1975) but *Eleutherascus* is usually placed in the Pyronemataceae as a primitive discomycete with naked asci. In most of its characters such as dark-colored cleistothecia, thin peridium, hyaline to pale yellowish brown ascospores with wing-like appendages and an *Acremonium* anamorph, *E. sphaerospora* fits fairly well in the genus *Emericellopsis* in the Pseudeurotiaceae (vide Eriksson and Hawksworth, 1986) but differs markedly from all other described species in the genus in ascospore shape (Davidson and Christensen, 1971; Gams, 1971; Beljakova, 1974).

On the other hand, the dark-colored peridium of the cleistothecia and the globose ascospores are suggestive of a close relationship to *Hapsidospora irregularis* Malloch et Cain (1970). *Hapsidospora* , a rarely encountered member of the Pseudeurotiaceae, was erected for a species with dark-colored cleistothecia and globose, dark reticulate ascospores. Beljakova (1975), however, has described a second species, *H. milkoi* Beljakova, that produces almost hyaline and ovoid ascospores with a reticulate ornamentation. Since *E. sphaerospora* has some intermediate characteristics that expand the traditional concept of *Emericellopsis* , generic delimitation between *Emericellopsis* and *Hapsidospora* becomes a little vague.

Kernia peruviana Udagawa et Furuya, sp.nov. (Figs. 2, 8-10)

St. anam. *Scopulariopsis*.

Ascomata superficialia vel immersa, dispersa, nigra, globosa vel subglbosa, 115-220 µm, non ostiolata, glabra; peridium 8-10 µm crassum, olivaceo-brunneum, membranaceum, "textura angularis", e stratis duobus compositum. Asci irregulariter dispersi, octospori, subglobosi vel ovoidei vel pyriformes, 8.5-11(-13) x 8-10 µm, evanescentes. Ascosporae unicellulares, dextrinoideae, pallide aurantio-brunneae, circiter triangulares, reniformes, ellipsoideae vel ovoideae, 3-4.5(-5) x 3-3.5(-4) µm, leves, "de Bary bubble" praeditae, apice poris germinalibus praeditae. Mycelium e hyphis hyalinis, ramosis, septatis, 1-3 µm diam, interdum ad septum usque 5-8.5 µm diam, levibus, discretis vel funiculosis compositum. Conidiophora macronemata, mononemata, plerumque e hyphis aeriis exorientia, hyalina, simplicia vel ramosa ad capitulum penicillatum, septata, levia, (8-)10-30 x 2.5-6 µm. Metulae plerumque 2-6 verticillatae, 8-12(-14) x 3-5 µm, sursum aliquantum inflatae, leves. Cellulae conidiogenae (annellides) 2-6 verticillatae, cylindricae, 5-12 x 2-3 µm, leves, cum zona annellata 2.5-4 µm longa, interdum solitariae. Conidia catenata, hyalina, in massa parum subrosea, ovoidea vel ellipsoidea vel cylindrica, 4-7.5 x 2-3.5 µm, basi truncata, apice subacuta vel rotundata, levia vel subtiliter asperula.

Holotypus: NHL 2985, colonia exisiccata, isolatus e solo, Tamshiyacu, prope Iquitos, in Peruvia, 9.vii.1987, legit. T. Akiyama. In Herbario NHL. Isotypus: SANK.

Etymology: Latin, *peruviana* =pertaining to Peru, referring to the country of type locality.

Ascomata arising from coiled swollen branches of the hyphae, superficial or immersed, scattered, black, opaque, globose to subglobose, 115-220 µm diam, non-ostiolate, glabrous except for a few short hyphal attachments; peridium 8-10 µm thick, olivaceous brown, membranaceous, composed of textura angularis, 2-layered; the outer layer consisting of brown, thick-walled, angular cells measuring 5.5-16 x 4-10 µm and the inner layer of hyaline, thin, flattened cells up to 25 mm diam. Asci irregularly disposed, 8-spored, subglobose to ovoid or pyriform, 8.5-11 (-13) x 8-10 µm, non-stipitate, evanescent. Ascospores one-celled, dextrinoid, becoming reddish orange in Melzer's reagent when young, light orange-brown, variable in shape, roughly triangular, reniform, sometimes ellipsoid or ovoid, 3-4.5(-5) x 3-3.5(-4) µm, smooth-walled, with a prominent de Bary bubble, with one or two germ pores per spore at the pointed ends.

Mycelium composed of hyaline, branched, septate, 1-3 µm diam, sometimes swollen up to 5-8.5 µm at the septum, smooth-walled hyphae, detached or aggregated in funicules. Conidiophores macronematous, mononematous, mostly arising from the aerial hyphae, hyaline, simple or penicillately branched, septate, smooth-walled, (8-)10-30 x 2.5-6 µm, bearing a cluster of metulae and conidiogenous cells. Metulae usually 2-6 in the verticil, 8-12(-14) x 3-5 µm, rather swollen upward, smooth-walled. Conidiogenous cells (annellides) 2-6 in the verticil, cylindrical, 5-12 x 2-3 µm, smooth-walled, with annellated zone 2.5-4 µm long, sometimes solitary as proliferating branches of the conidiophore. Conidia produced in tangled or loosely columnar chains up to 80-160 µm long, hyaline, slightly

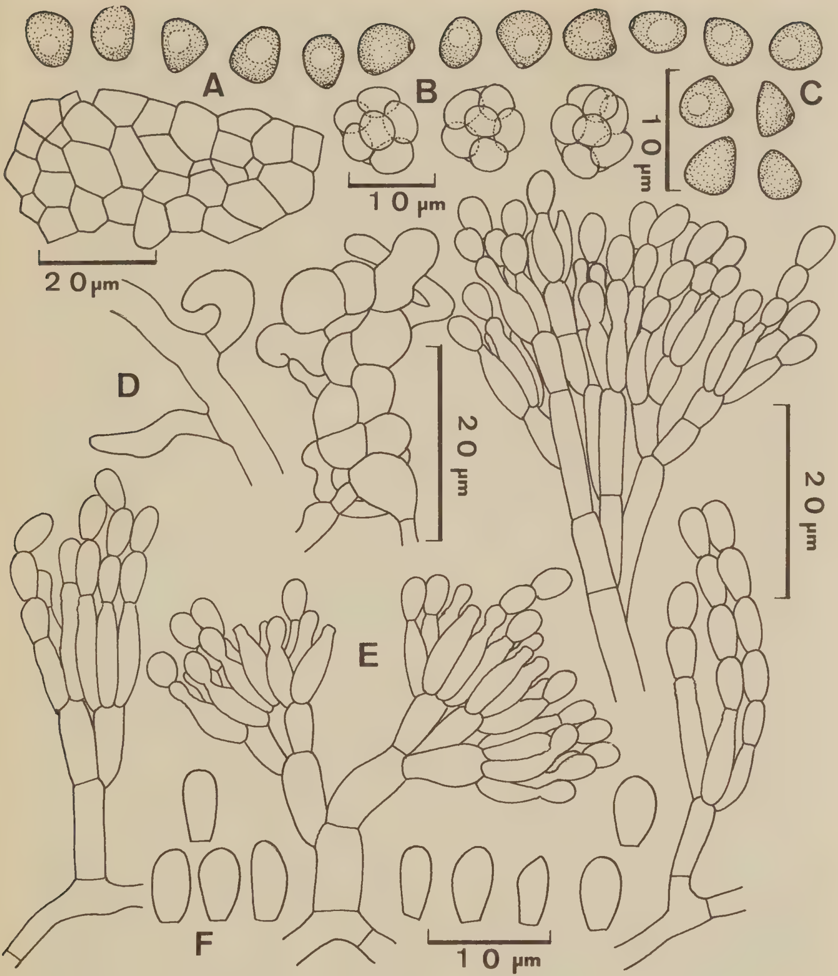


Fig. 2. *Kernia peruviana* , NHL 2985.
A. A portion of peridium. B. Asci. C. Ascospores.
D. Ascomatal initials. E. Conidiogenous cells and conidia.

pinkish in mass, ovoid to ellipsoid or cylindrical, 4-7.5 x 2-3.5 µm, truncated at the base and slightly pointed or rounded at the apex, smooth-walled or finely roughened.

Colonies on oatmeal agar with 2 per cent urea spreading broadly, attaining a diameter of 85 mm within 2 weeks at 23°C, thin, vegetative mycelium submerged, grayish brown (M. 7E3, after Kornerup and Wanscher, 1978) or "Olivaceous Grey" (Rayner, 1970), producing numerous ascomata in a thin layer at the agar surface or into the substratum, commonly surrounded by sparse hyphal networks and conidia to give a reddish gray (M. 7B2) or "Vinaceous Buff" (Rayner) color to the colony; reverse uncolored to brownish orange (M. 6C3) or "Fawn" (Rayner).

At 37°C, growth is nil.

Specimen examined: a dried colony isolated from soil, Tamshiyacu, near Iquitos, Peru, July 9, 1987, coll. T. Akiyama, NHL 2985, holotype.

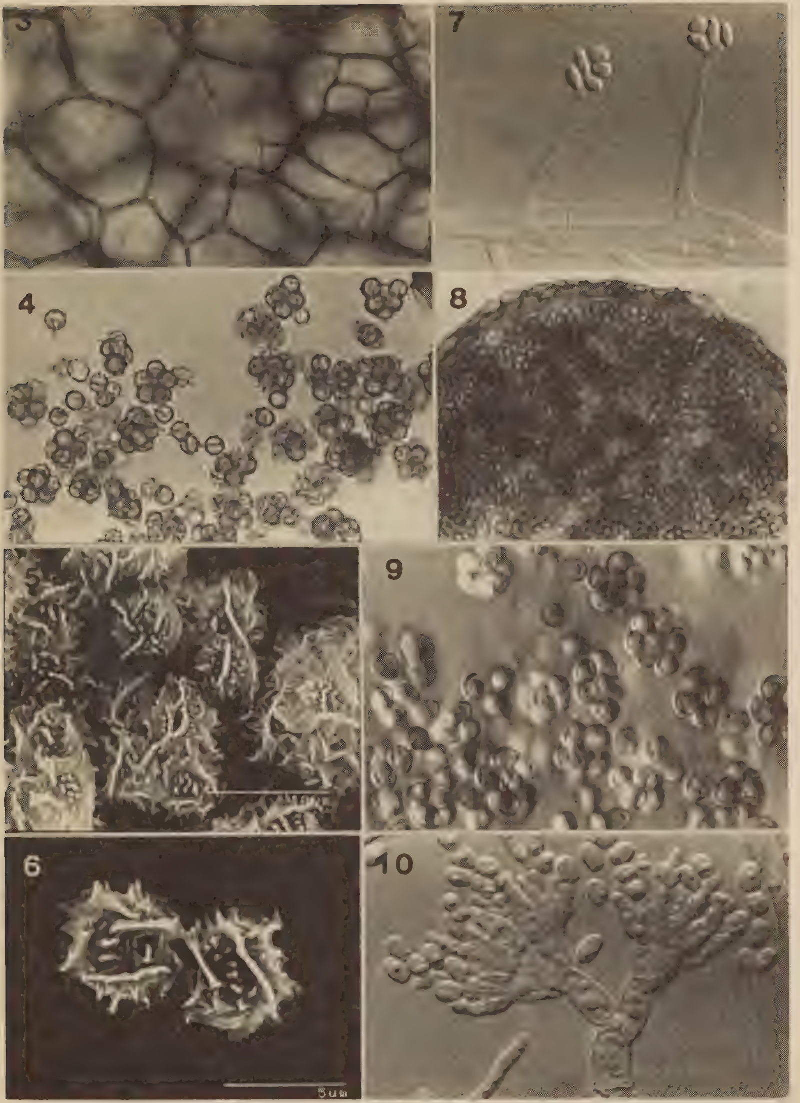
Subculture derived from the holotype has been deposited with Fermentation Research Laboratories, Sankyo Co., Ltd., Tokyo (SANK).

The genus *Kernia* Nieuwland in the Microascaceae, essentially a cleistothecial counterpart of *Microascus* or *Petriella* , has been revised by Malloch and Cain (1971) to accommodate five species. Some additional species have been described subsequently (Lodha, 1971; Malloch and Cain, 1973; Locquin-Linard, 1977, 1980; Calviello, 1979; Udagawa and Muroi, 1981). Anamorphs of *Kernia* include genera such as *Graphium* Corda and *Scopulariopsis* Bainier in which conidiogenesis is characterized by typical annellations. The anamorph of *K. peruviana* is regarded as properly assignable to the form-genus *Scopulariopsis*.

Kernia peruviana is distinguished from the other species of *Kernia* by its rapid growth upon common substrata, glabrous and thin-walled ascomata, roughly triangular to reniform ascospores, and the pinkish color of its massed conidia. The small dimensions of its ascospores particularly differ from the other species. In the description of *K. hippocrepida* Malloch et Cain(1971), they recognized only a strain (TRTC 43764) from porcupine dung but called attention to the presence of considerable variability in the ascospore dimensions among the specimens which they had observed. The sizes of ascospores of these specimens are as follows:

The holotype of *K. hippocrepida* , TRTC 43764, 5.0-7.0 x 4.2-6.0 x 4.0-5.5 µm; Fairman collection (in Farrow Herbarium, Harvard University, as *Fairmania singularis* Sacc.), 4.0-5.5 x 3.5-5.0 x 3.5-4.2 µm; and TRTC 33490 and 33491, 4.5-5.0 x 3.8-4.2 x 2.8-3.2 µm.

Malloch and Cain (1971) stated that there is no overlap between the dimensions of the largest and smallest and thus two species might be established but said that "Only one collection (TRTC 43764) has been studied in culture, the other collections being old and dead ......



Figs. 3-7. *Emericellopsis sphaerospora* , NHL 2984;
8-10. *Kernia peruviana* , NHL 2985.
3. A portion of peridium, x1000. 4. Asci. x600.
5. Asci (SEM photograph). x1600. 6. Ascospores (SEM photograph). x2800. 7. Conidiogenous cells and conidia. x750. 8. Cross section of ascoma. x480. 9. Asci. x900. 10. Conidiogenous cells and conidia. x1000.

there is no way of knowing whether or not they would appear identical in culture." In view of these observations and reniform ascospore shape, the Fairman collection and the latter two TRTC specimens are considered to be almost identical with *K. peruviana.* Since *K. peruviana* is now represent by a single strain and there is some discrepancy concerning the presence or absence of *Scopulariopsis* anamorph, decisive treatment of these specimens must await further isolation of essentially duplicate strains. In the case of the Fairman collection, the associated anamorph is similar to that of TRTC 43764, in which the conidiophores are most commonly united into synnemata of the *Graphium* type.

Kernia peruviana is apparently favored by a culture substrate to which a 2% concentration of urea has been added, not only spreading broadly (reaching more than 85 mm diam after 14 days at 23°C on oatmeal agar containing urea instead of 36-40 mm diam on conventional oatmeal agar under the same cultural condition) but also producing numerous cleistothecia throughout the colony.

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MYCOTAXON

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TYPE STUDIES IN THE POLYPORACEAE - 20

SPECIES DESCRIBED BY G. BRESADOLA

by

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SUMMARY

Bresadola described 149 polypores out of which 46 are accepted, 97 are synonyms, 5 names are illegitimate and the type has not been found for one species. The following new combinations are proposed: **Antrodia hippophaes, Antrodia parvula, Ceriporiopsis cerrussata, Ceriporiopsis consobrina, Datronia decipiens, Grammothele pulchella, Fomitopsis avellanea, Perenniporia latissima, Perenniporia straminea, Perenniporia straminella, Phellinus mcgregorii, Phellinus reichingeri, Phellinus rufus, Trametes bresadolae, Tyromyces marianii** and **Tyromyces squamulosus. Trametes radiato-rugosa** is proposed as nomen novum.

Bresadola described a large number of fungi and among them also a fair number of polypores. The types of these have been examined and the result is given in the following. The species are treated alphabetically according to specific epithet. After the name it is indicated in which herbarium the type material was examined. If the species is a synonym this is indicated and if it is accepted, its proper genus is given with a reference to a modern description. If none is available, the species is described and illustrated.

allardi, Fomes (S)
Bull. Jard. Bot. Brux. 4:19,1914. Bambata, Zaire.
= **Phellinus allardi** (Bres.) Ryv.
For a description, see Ryvarden & Johansen 1980:139.

ambigua, Poria (BPI)
Att. Acc. Rov. ser. 3, 3:84,1897. Trento, Italy.
= **Oxyporus latemarginatus** (Dur. & Mont.) Donk as indicated by Lowe (1966:17).

aulaxinus, Fomes (FH)
Ann. Mycol. 10:497,1912. Tjibodas, Indonesia.
= **Phellinus rimosus** (Berk.) Pil.

avellanea, Poria (S)
K. Akad. Wiss. Math.-Naturw. Klasse Denkschr. 83:14,1907. Santos, Brazil.
= **Wrightoporia avellanea** (Bres.) Pouz.
For a description, see Gilbertson & Ryvarden 1987:803.

avellanea, Trametes (NY,S)
Kryptog. Exsci. Vidbond. 20:157,1910. Madagascar.
= **Fomitopsis avellanea** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody pileate, applanate, tough, dimidiate to broadly sessile, up to 12 cm wide and long,1.5 cm thick at the base, thin and flexible at the margin. Pileus glabrous, slightly zonate and warted with some radial lines when dry, first isabelline to pale pinkish brown at the margin, then paler and more beige and with age becoming indurated and darker brown from the base, but no distinct cuticle present, pore surface pale isabelline to very pale pinkish brown, pores round, 5 per mm, tubes distinctly stratified, whitish, up to 1 cm totally,1-3 mm in individual layers, context cinnamon-pink distinctly darker than the tubes. Hyphal system trimitic, context and trama dominated by skeletal hyphae, 3-6.5 µm wide in the context and with distinct lumen, tinted pale yellowish pinkish brown in KOH and Melzers solution looking almost dextrinoid in masses, flexuous in trama, narrower and solid, a few dichotomously branched , 3-5 µm wide. Tortuous binding hyphae present, but few, scattered only in the context, generative hyphae with clamps. 2-3 µm wide. Spores not seen.
The species is undoubtedly close to **F. dochmius** (Berk.) Ryv. from the tropical Asia, but keeps its isabelline colour fairly well and only at the base there are a slight tendency to radial cracking being so prominent in **F. dochmius** which moreover is far more gray to almost black.

balansae, Favolus
Stud. Trent. 2:58,1926.
Type not found.

bicolor, Poria (BPI)
Ann. Mycol. 18:37,1920. Brazil.
= **Phellinus contiguus** (Pers.:Fr.) Pat. as already indicated by Lowe.(1966:154).

bosei, Polyporus (BPI)
Stud. Trent. 2:55,1926. Bakurganj, India.
= **Coriolopsis pruinatus** (Kl.) Ryv.

cacinum, Ganoderma (BPI)
Ann. Mycol. 18:37,1920. Zaire.
= **Ganoderma chalceum** (Cooke) Stey. as indicated in Steyaert (1967:).

canescens, Polyporus (BPI)
Ann. Mycol. 12:540,1914. New Guinea.
Nomen illegit, non **P. canescens** Karst. ex Romell.
The type specimen is small and poorly developed. Its identity is unknown to me.

carneola, Poria (S)
Hedwigia 35:282,1896. Brazil, Blumenau.
= **Junghuhnia carneola** (Bres.) Rajchenb.
For a description, see Ryvarden & Johansen 1981.

cerina, Trametes (BPI)
Mycologia 17:74,1925. Cuba.
= **Coriolopsis byrsina** (Mont.) Ryv.

cerussata, Poria (BPI) Fig. 1 A,B.
Stud. Trent. 2:57,1926. Brazil, Sao Lepoldo.
= **Ceriporisopsis cerrusata** (Bres.) Ryv. comb. nov. Basionym as cited above.
Basidiocarp annual, resupinate, fragile in tubes, pore surface white, pores angular, 2-3 per mm, tubes 2 mm deep, context thin, white and cottony. Hyphal system monomitic, generative hyphae with clamps, thick-walled and distinct, moderately branched, 3-7.5 µm wide, cystidia not seen, basidia with 4 sterigmata and a basal clamp, 22-26 x 4-5 µm, spores subcylindrical, smooth, hyaline and thin-walled, IKI-, 8-10 x 3-4.5 µm.
The species is placed in **Ceriporiopsis** by its monomitic hyphal system with clamps and the generative hyphae and the hyaline subcylindrical spores. It is separated from the type species, **C. aneirina** (Fr.) Dom. by the larger spores.

cervinum, Ganoderma (BPI)
Engler Bot. Jahrb. 54:249,1916. New Guinea.
= Accepted species, belongs in the **Ganoderma lucidum** complex.

cesatii, Poria (BPI)
Stud. Trent. 2:57,1926. Sarawak.
= **Phellinus gilvoides** (Petch) Ryv.

chrysellus, Polyporus (BPI).
Ann. Mycol. 18:33,1920. Australia.
= **Phellinus gilvus** (Schw.) Pat.

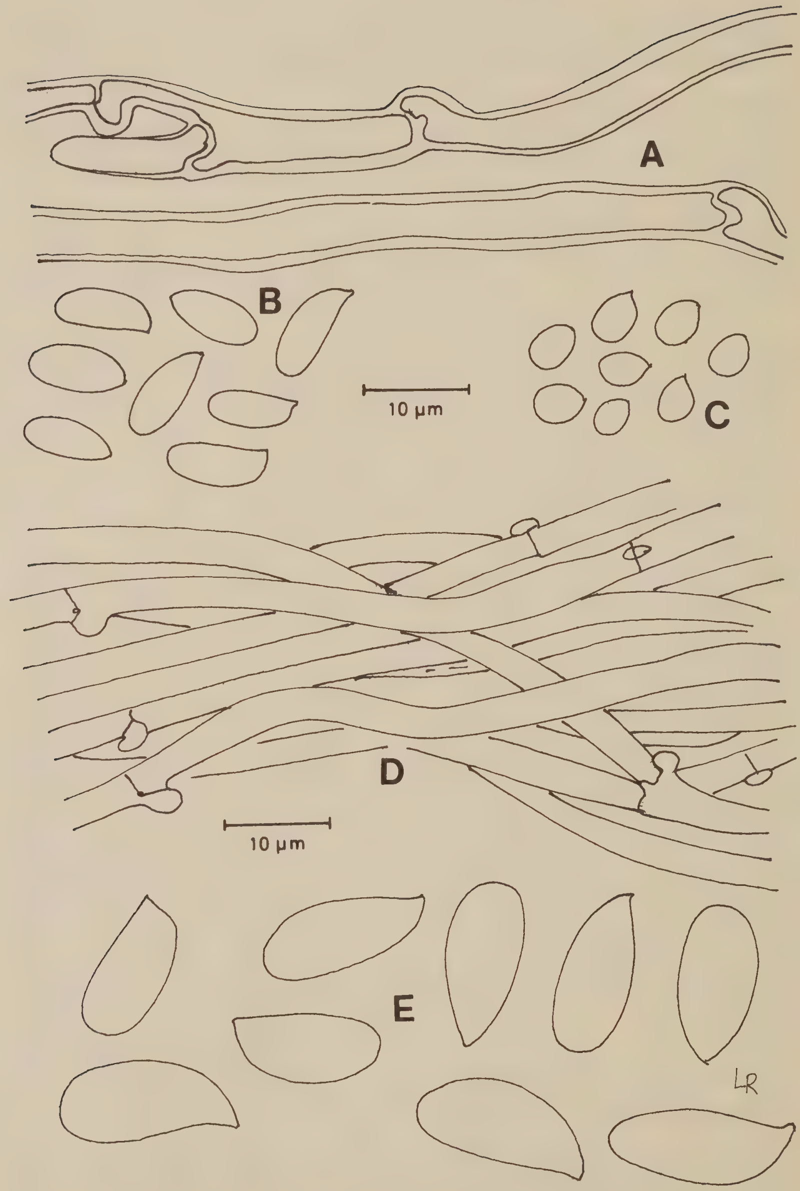

Fig. 1. **Ceriporiopsis cerrusata:** A) Generative hyphae, B) Spores. **Ceriporiopsis consobrina:** C) Spores, D) Generative hyphae. **Datronia decipiens:** E) Spores. From the types.

cineracea, Grammothele (S).
Hedwigia 56:299,1915. Luzon, Baatan Mts., Philippine Islands.
= **Grammothele lineata** Berk. & Curt.

citrina, Trametes (S).
Ann. Mycol. 18:39,1920. Brazil.
= **Daedalea aethalodes** (Mont.) Rajchenb.

conchata, Daedalea (S).
Bull. Soc. mycol. Fr. 6:47,1890. Cameroon.
= **Earliella scabrosa** (Pers).Gilbn. & Ryv.

confusa, Poria (S).
Atti Accad. Sci. Rov. 3:87,1897. Prencov, Hungary.
= **Schizopora flavipora** (Cooke) Ryv.

consobrina, Poria (FH, S). Fig. 1 C,D.
in Bourdot & Galzin. Hymén. de France p. 671,1928. Germany Type locality unknown, not indicated neither in the description nor on the original label. As the type locality was collected by Bresadola himself, it is probably from the Trento-area in North Italy.
= **Ceriporiopsis consobrina** (Bres.) Ryv. comb. nov. Basionym cited as above.
Fruitbody resupinate, annual, detachable and fragile when dry, up to1 mm thick, type approximately 4 x 1 cm, margin white and thin, rather wide, pore surface cream to pale straw-coloured, reminds in colour of **Schizopora paradoxa**, pores angular, lacerate to dentate, 1-2 (3) per mm, subiculum very thin, and white.
Hyphal system monomitic, generative hyphae with clamps, 2-4 µm wide, hyaline and delicately thin-walled, those of the margin and subiculum finely encrusted, cystidia not seen, cystidoles present, presumably aborted basidia, basidia 12-18 x 3-5 µm with 4 sterigmata, spores subglobose, hyaline, thinwalled,3-4 x 2.5-3 µm, IKI-.
This species reminds strongly about **Schizopora paradoxa** in colour and hymenial configuration, but is separated easily microscopically by the monomitic hyphal system, no pointed or bulbuous cystidiols and far smaller spores. **Skeletocutis subsphaerospora** David, for a description, see David 1982: 265, is almost identical, separated mainly by its smaller pores (4-5 per mm). The encrustation of the basal hyphae is identical and so is the hyphal structure in general and the spores. It may be that the two species represent the same taxon having a variable number of pores per mm. Bresadola's name will of course in such a case has the priority.
I am personally not convinced that the encrustation as such represent a more basal character than the other microscopical characters. Because of the monomitic hyphal system and the small subglobose spores , this species should be placed in the same genus as **Polyporus mucidus** Pers.:Fr., which has the same characters but smaller pores and smooth basal hyphae. The type of

Skeletocutis, i.e. **S. amorphus** is a coloured species with a trimitic hyphal system and tiny allantoid spores, viz. rather different from those described for **Poria consobrina**.

cremeus, Polyporus (S).
Ann. Mycol. 18:35,1920. San Leopoldo, Brazil.
= **Antrodiella versicutis** (Berk. & Curt.) Gilbn. & Ryv.

croceo-pallens, Gloeoporus (S).
Ann. Mycol. 10:506,1912. Tjibodas, Indonesia.
= Accepted in the genus, for a description, see Ryvarden & Johansen (1980:355).

crustulinus, Polyporus (S).
Hedwigia 56:293,1915. Luzon, Philippine Islands.
= **Antrodiella** cfr. **versicutis** (Berk. & Curt.) Gilbn. & Ryv.
The spores are slightly shorter than seen in American specimens, but otherwise the macro- and microscopical characters are similar to those seen in **A. versicutis**.

crustulina, Poria (BPI).
Mycologia 17:75,1925. Washington,USA.
= **Diplomitoporus crustulinus** (Bres.) Dom.
For a description, see Gilbertson & Ryvarden 1986:241.

cuprea, Hexagonia (S).
Ann. Mycol. 9:270,1911. Kunsuka,Zaire.
= **Hexagonia tenuis** (Hooker) Fr.

decipiens, Tram. (S). Fig. 1 E.
Ann. Mycol. 18:40,1920. Bahia, Brasil.
= **Datronia decipiens** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody effused-reflexed, pileus dark brown, zonate, tomentose, pore surface dark brown, pores angular, about 1 mm wide, tubes concolorous, up to 3 mm deep, context dark brown, duplex, lower part brown, separated from the upper looser part by a distinct black zone. Hyphal system dimitic, generative hyphae hyaline and with clamps at the septa, 2-4 µm wide, skeletal hyphae pale brown, solid to thickwalled, in the trama thin and flexuous,2-3 µm wide, some hyphae with short side-branches, in the context straight and wider, 3-6 µm wide, basidia with 4 sterigmata 25-35 x 6-7 µm, cystidia or other sterile organs not seen, spores ellipsoid to subcylindrical, hyaline to pale yellow 14-16 x 6-8 µm, IKI-.
The species is separated from other species in the genus by its large pores and spores, in most other species in **Datronia**, the spores are cylindric. Fresh specimens of this species was recently collected in Southern Brazil indicating a wide distribution in South America.

delicata, Grammothele (BPI).
Hedwigia 56:299,1915. Panay, Iloilo, Philippine Islands.
= **Junghuhnia crustacea** (Jungh.) Ryv.

devians, Polyporus (S).
Ann. Mycol. 18:32,1920. Zumbo, Mozambique.
= **Pseudopiptoporus devians** (Bres.) Ryv.
For a description, see Ryvarden & Johansen 1980:524.

dialeri Fomes (S,FH).
Broteria 4:218,1905. Mozambique.
= **Phellinus rimosus** (Berk.)Pil.

dichroa, Poria (BPI).
Mycologia 17:75,1925. Idaho,USA.
= **Antrodia albo-brunnea** (Rom.) Ryv. as already indicated by Lowe 1966:104.

ehretiae, Polyporus (BPI).
Stud. Trent. 2:56,1926. Java.
= **Trichaptum biforme** (Kl. in Fr.) Ryv.

elaphinus, Fomes (BPI).
Ann. Mycol. 18:36,1920. Japan.
= **Phellinus setulosus** (Lloyd)Imaz.

expallens, Ganoderma (K).
Mycologia 17:72,1925. Uganda.
= **Amauroderma expallens** (Bres.) Furt.
For a description, see Ryvarden & Johansen 1980:125.

expallida, Hexagonia (BPI).
Ann. Mycol. 9:270,1911,Kisantu, Zaire.
= **Coriolopsis telfarii** (Kl.) Ryv.

eyrei, Poria (S).
Trans. Br. mycol. Soc. 3:264,1910.England,Candover.
= **Schizopora paradoxa** (Pers.:Fr.) Donk.

fagicola, Poria (BPI).
Mycologia 17:75,1925. Washington DC, USA.
= **Ceriporia tarda** (Berk.) Ginns.

filipponei, Trametes (BPI).
Stud. Trent. 2:58,1926. Montevideo, Uruguay.
= **Coriolopsis floccosa** (Jungh.) Ryv.

flavescens, Trametes (S).
Ann. Mycol. 1:81,1903. Poland.
= **Diplomitoporus flavescens** (Bres.) Dom.

floccosa, Trametes (S).
Nomen nov. for **Fomes introstuppeus** Henn. 1892, non **F. introstuppeus** (Berk. & Cooke) Sacc. 1888.
Ann. Roy. Inst. Roma 6:179,1896. Tanzania.
= **Navisporus floccosa** (Bres.) Ryv.

For a description, see Ryvarden 1983:411.

friesiana, Poria (BPI).
Ann. Mycol. 6:40,1908. Allier, France.
= **Phellinus punctatus** (Fr.) Pil.

friesii, Polyporus (BPI).
Nomen llegit. non **P. friesii** Kl. 1833.
The type of Bresadola's name is a specimen of **Inonotus dryophilus** (Fr.) Karst.

fulvella, Poria (BPI).
Mycologia 17:76,1925. Idaho, USA.
= **Anomoporia bombycina** (Fr.) Kotl.

fulvellum, Ganoderma (FH).
Bull. Soc. mycol. France 5;69,1889. Cameroon.
= **Ganoderma lucidum** s lato.

fulvescens, Poria (BPI).
Atti Agiati Rov. 3:81,1897. Prencov, Hungary.
= **Ceriporiopsis aneirina** (Fr.) Dom. as indicated by Bresadola himself 1920:69.

fulviseda Poria (BPI).
Ann. Mycol. 18:37,1920. Cavara,Italy.
= **Perenniporia fulviseda** (Bres.) Hallenb.
For a description and coloured picture, see Keller 1986:9-10.

fulvo-umbrina, Fomes (FH, K).
Hedwigia 35:280,1896. Brasil.
= **Pyrofomes fulvo-umbrina** (Bres.) David & Rajchenb.
For a description, see David & Rajchenberg 1985:313.

fumigatus, Polyporus (BPI,FH,S).
Ann. Mycol. 10:503 ,1912. Tjibodas, Java, Indonesia.
= **Microporellus obovatus** (Jungh.) Ryv.

fumosa, Poria (BPI).
Lloyd Mycol. Writ. 1, Mycol. Notes 6:49,1901. Samoa.
= **Rigidoporus vinctus** (Berk.) Ryv.

fuscobadius, Polyporus (BPI).
Hedwigia 56:293,1915. Mindanoa, Philippine Isl.
= **Inonotus patouillardii** (Rick.) Imaz.

fusco-maculatus, Polyporus (BPI).
Lloyd Mycol. Writ. 1, Mycol. Notes 6:49,1901. Samoa.
= **Polyporus udus** Jungh.

fusco-pallens, Fomes (BPI).
Hedwigia 56:294,1915. Luzon, Bataan, Philippine Isl.
= **Ganoderma mirabilis** (Lloyd) Humphrey

gilvescens, Poria (BPI).
Ann. Mycol. 6:40,1908. Voges, France.
= **Ceriporiopsis gilvescens** (Bres.) Dom. For a description, see Ryvarden 1978:465.

gilvidula, Daedalea (S).
Hedwigia 51:320,1912. Sibuya, Mt. Giting, Philippine Isl.
= **Daedalea incana** (Lév.) Ryv.

gilvo-umbrina, Trametes (S).
Ann. Mycol. 18:38,1920. San Leopoldo, Brazil.
= **Daedalea aethalodes** (Mont.) Rajchenb.

goethartii, Polyporus (L).
Ann. Mycol. 8:588,1910. Java.
= **Phellinus adamantinus** (Berk.) Ryv.

graffianus, Polyporus (S).
Hedwigia 56:291,1915, Luzon, Baatan, Philippine Isl.
= **Microporellus cfr. obovatus** (Jungh.) Ryv.
The type is larger than normally seen in this species, but the microscopical characters are otherwise similar altough the spores are slightly smaller. They may however only represent immature spores and more collections are needed to verify if this character is consistent and reliable for a separation of two species.

graphica, Poria (BPI). Fig. 2 A,B,C,D.
Hedwigia 35:282,1896. Brazil.
= **Porogramme graphica** (Bres.) Pat.
Fruitbody resupinate, adnate. Pore surface beige to very pale brown. Pores a fine irregular angular pattern 8-12 per mm, 0.1-0.2 mm deep. Context almost lacking, trama in section cream to very pale straw-coloured. Substrate somewhat reddish brown below the fruitbody but irregular and faint. Hyphal system monomitic. Generative hyphae with clamps, in the upper parts of the sterile walls and in the hymenium thin-walled 2-4 µm wide, in the trama slightly thick-walled, agglutinated 3-5 µm wide and thick-walled to solid. Hymenium only in the bottom the shallow pores, basidia 16-22 x 4-6 µm, clavate with 4 sterigmata. Spores broadly cylindrical 5.5-7 x 2.5-3 µm, thin-walled, IKI-. Some hyphae projecting into the hymenium, up to 3 µm wide. Characteristic is the very thin, slight beige to very pale brown surface and the very finely tinted hyphae.

greschikii, Poria (BPI).
Ann. Mycol. 18:38,1920.Locse, Hungary.
= **Antrodia xantha** (Fr.) Ryv. as indicated by Lowe (1966:88).

griseus, Polyporus (BPI).
Ann. Mycol. 10:494,1912.Colombo,Sri Lanka.
Illegitimate name not **P. griseus** Peck 1874.
The type specimen of Bresadolas illegitimate species is a

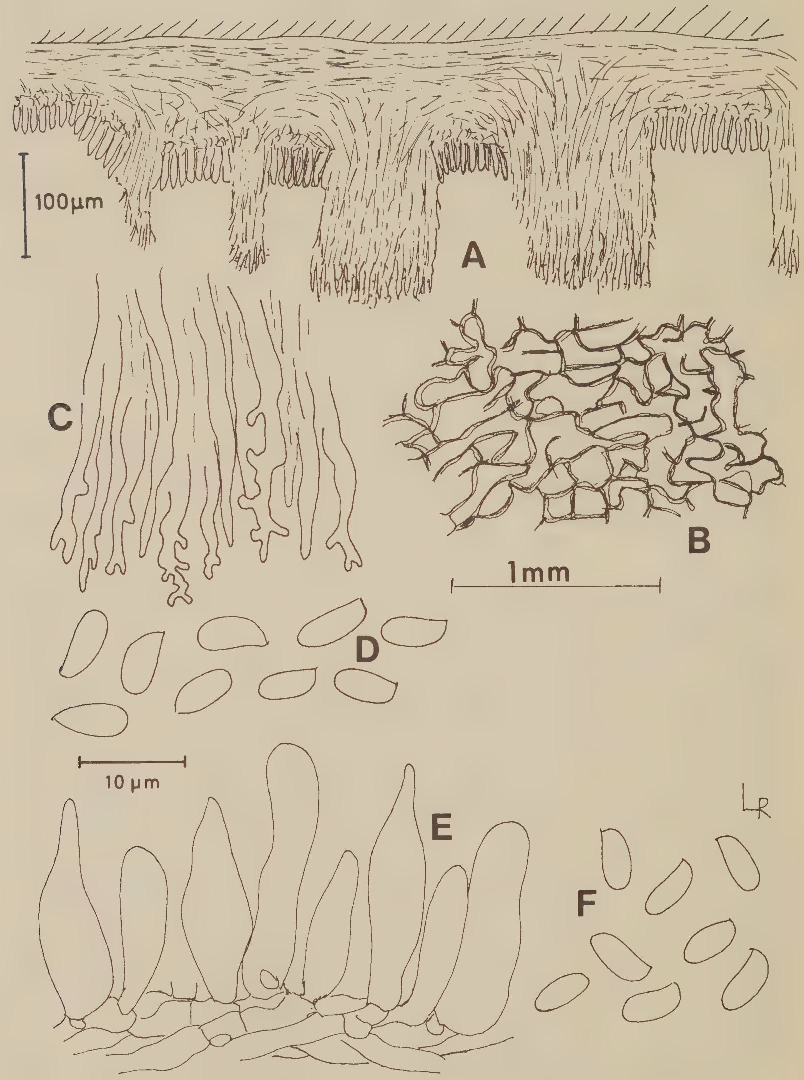
100µm
A
C
B
1mm
D
10 µm
E
LR
F

Fig. 2. **Porogramme graphica:** A) Section through fruitbody, B) Pore surface, C) Dendrohyphidia from dissepiments, D) Spores (from Lowe 13166, SYRF, Costa Rica). **Antrodia hippophaes:** E) Part of hymenium, F) Spores. From the types.

specimen of **Trametes cingulata** Berk.

hippophaes, Poria (BPI). Fig. 2 E,F.
Stud. Trent.2:57,1926. Wien, Österreich.
= **Antrodia hippophaes** (Bres.) Ryv. comb. nov. Basionym as cited above.
This seems to be a prior name for **Antrodia pulvinascens** (Pil.) Niem. For a description, see Niemelä 1978 and 1985.
The type of **A. hippophaes** is pulvinate, up to 1 cm thick in the center and with a pale woody colour. The spores are slightly shorter than those given for **A. pulvinascens**, i.e. 5-6 x 2-3 µm (6-7 x 2.7-3.2 µm for **A. pulvinascens**. Further all collections hitherto known from **A. pulvinascens** have been made on hosts of Salicaceae. The type of **Poria hippophaes** was collected on **Hippopae rhamnoides**. It may be that two species are involved. Further collections on **Hippophae** in Central Europe may shed light on this problem.

hippopus, Fomes (NY, U).
Bull. Soc. mycol. Fr. 6:42,1890., America australe.
= **Perenniporia martius** (Berk.) Ryv.

hoehnelii, Daedalea (FH).
Ann. Mycol. 10:507,1912. Buitenzorg, Indonesia.
= **Trametes bresadolae** Ryv. Nomen novum, not **Trametes hoehnelii** (Bres.) Pil.,see below.
Fruitbody dimidiate, semicircular, 7 cm wide, 5 cm broad, 3 cm thick at the base, margin acute and curved downwards in the type, woody, pileus velutinate, adpressed tomentose, ochraceous, strongly sulcate and zoned, pore surface pale straw-coloured, pores angular, in parts split and semidaedaleoid,1-2 per mm, tubes ochraceous, up to 8 mm deep at the base, context wood-coloured , duplex, dense in the lower part,distinctly looser in the tomentum. Hyphal system trimitic, generative hyphae hyaline and clamped, 2-3 µm wide, skeletal hyphae solid to very thick-walled, 2-4 µm wide, binding hyphae tortuous, solid, 2-4 µm wide. Spores not seen.
The species is placed in **Trametes** because of the trimitic hyphal system and the duplex consistency reminiscent of both **T. hirsuta** (Fr.) Pil. and **T. tephroleucus** Berk. which both however have a white context and more regular pores.

hoehnelii, Fomes (FH).
Ann. Mycol. 10:499,1912. Buitenzorg, Java, Indonesia.
= **Phellinus hoehnelii** (Bres.) Ryv. For a description, see Ryvarden & Johansen 1980:173.

hoehnelii, Polyporus Bres.
in Hoehn. Fragm. mycol. 14:6,1912. Hungary
= **Antrodia hoehnelii** (Bres.) Niem. For a description see Ryvarden 1976-78:428.

hoehnelianum, Ganoderma (FH).
Ann. Mycol. 10:502,1912. Tjibodas, Java, Indonesia.
=Accepted in the genus.
Fruitbody pileate, dimidiate with contracted base, woody, 5 cm broad, 8 cm wide and up to 1 cm thick at the base, pileus glabrous, tuberculate to wrinkled, dark brown, dull to slightly shiny on the most exposed parts, a thin crust present in section, pore surface ochraceous to pale yellowish brown, pores 5-6 per mm, but with thick porewalls and pores hardly visible to the naked eye, tubes brown, up to 6 mm deep, context homogeneous, cork to wood-coloured. Hyphal system dimitic, generative hyphae with clamps, 2- 5 µm wide, vegetative hyphae consisting of sparingly to richly branched arboriform skeletal hyphae, pale yellow, thick-walled to solid with tapering hyphal ends, 3-8 µm wide,the crust consists of agglutinated dark hyphae as in **G. applanatum** and no palisade-structure as in the **G. lucidum** complex could be observed, spores subglobose, finely ornamented, pale brown,11 - 13 x 9 -10 µm.
The species belongs to a group of **Ganoderma** species with wood-coloured context and a densely agglutinated crust with random hyphal orientation and subglobose spores with only a slight truncate apex. A species in the same complex is **G. ostracodes** Pat. which however, has spores only 6,5-8 x 6-7 µm and a crust of vertical hyphal ends.

hypoxanthus, Polyporus (FH).
Ann. Mycol. 1o, 494,1910. Tjibodas, Java, Indonesia.
= **Fomitopsis spraguei** (Berk.) Gilbn. & Ryv. although the pores are slightly larger than normal.

kmetii, Polyporus (S).
Atti Acad. Sci. Lett. Roverto 3:70,1897. Prencov, Hungary.
= **Tyromyces kmetii** (Bres.) Bond. & Sing.
For a description, see Ryvarden 1978:470.

latissimus, Fomes (S, isotype in K).
Ann. Mycol. 8:588,1910. Java.
= **Perenniporia latissima** (Bres.) Ryv. comb. nov. Basionym as cited above.
The species is recognized by its large encrusted cystidia. After having examined more specimens I have become convinced that this is a good species and should not be merged with **P. martius** (Berk.) Ryv. as suggested in Ryvarden & Johansen 1980:469.
See also Corner 1987:240.

leucoxanthus, Polyporus (BPI).
Mycologia 17:73,1925. Virginia, USA.
= **Antrodiella semisupina** (Berk. & Curtis) Ryv.

lignicolor, Trametes (BPI).
Ann. Mycol. 18:39,1920. Mauritius.
= **Coriolopsis pruinatus** (Kl.) Ryv.

luteo-velutinus, Polyporus (BPI).
Ann. Mycol. 18:34,1920. San Leopoldo, Brasil.
= **Trametes versicolor** (L.:Fr.) Pil.

malacotis, Polyporus (BPI).
Ann. Mycol. 18:33,1920. Japan.
= **Tyromyces leucomallus** (Berk & Curt.) Murr.

marianii, Polyporus (BPI). Fig. 3 A,B.
Nuovo Giorn. Bot. Ital. 7:313,1900. Terracina,Italy.
= **Tyromyces marianii** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody annual, pileate, dimidiate, imbricate, rather fragile when dry, individual pilei up to 5 cm wide and broad,1 cm thick, pileus white to wood-coloured, slightly scrupose to adpressed tomentose, pore surface cream, pores round to angular, 4-5 per mm, tubes up to 3 mm deep, context white to pale cream, dense and fibrous, homogeneous.
Hyphal system monomitic (?), generative hyphae in subhymenium and parts of context hyaline, delicately thin-walled and with numerous clamps, also present are thick-walled hyphae looking like skeletal hyphae, but with a few scattered clamps, thick-walled to solid, very variable in diameter, 3-1o µm wide, rarely branched, they may be interpreted as sclerified generative hyphae, basidia and cystidia not seen, spores hyaline, thin-walled and in parts collapsed, cylindric, 6,5-8 x 2,5-3 µm, IKI-.
Only known from the type which was found on **Quercus cerris.**
The species looks like a specimen of **T. chioneus** (Fr.) Karst., but the large spores immediately rules out this species.
Externally it may also remind one of **Oligoporus obductus** (Berk.) Gilbn. & Ryv., but this is normally a thinner species normally growing on coniferous wood and has a different hyphal system also the spores are shorter. **T. marianii** must be rare in Europe and it has seemingly been forgotten for many years.

mcgregorii, Fomes (BPI). Fig. 3 C.
Hedwigia 53:58,1913. Luzon, Benquet,Philippine Islands.
= **Phellinus mcgregorii** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody perennial, effused-reflexed, nodulose, up to 1 cm wide, up to 1 cm thick measured vertically, upper surface velutinate, snuff brown, becoming glabrous and almost black with a thin cuticle,sulcate and dull, pore surface dark brown, pores 4-5 per mm, tubes concolorous, up to 8 mm deep, context very thin, dark brown.
Hyphal system dimitic, generative hyphae rare, simple septate, 2-4 µm wide, skeletal hyphae totally dominating, rusty brown, 3-5 µm wide, setae none, spores ellipsoid, rusty brown, slightly thick-walled, 4,5-5,5 x 3,5-4 µm. IKI negative.

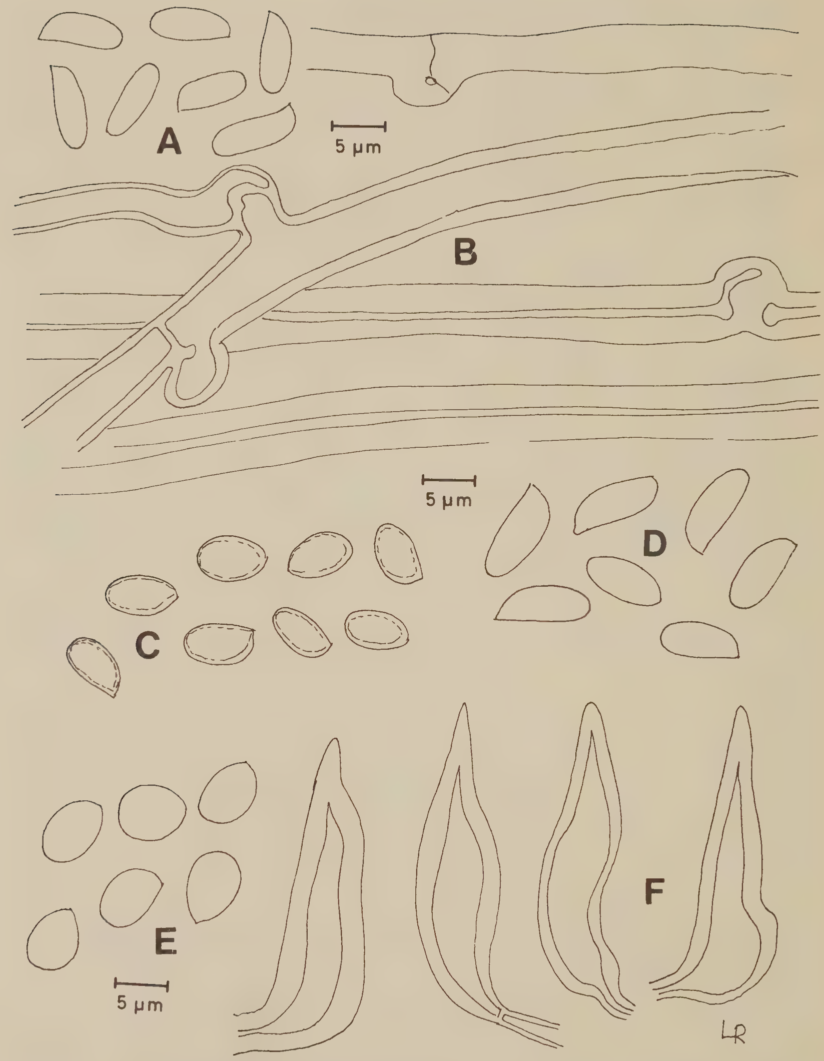
A
5 µm
B
5 µm
C
D
E
5 µm
F
LR

Fig. 3. **Tyromyces marianii:** A) Spores, B) Thin- and thick-walled hyphae. **Phellinus mcgregorii:** C) Spores. **Antrodia parvula:** D) Spores. **Phellinus reichingeri:** E) Spores, F) Setae. From the types.

The species is undoubtedly related to the **Phellinus badius-rimosus** complex, but is separated by its effused reflexed fruitbody (usually ungulate and deeply cracked in **Phellinus rimosus** and **P. badius**) but above all by the oblong spores being subglobose in the other species mentioned above.

melaleucus, Polyporus (FH).
Ann. Mycol. 10:492,1912. Tjibodas, Java, Indonesia.
= **Polyporus** s. str. cfr. **P. infernalis** Berk. The type of Bresadola's species has the same type of very thickened Bovista-like binding hyphae as in **P. infernalis**, see Ryvarden & Johansen 1980:498. The type is fertile with spores 6-7 x 3-3,5 µm while the spores for **P. infernalis** are unknown. The latter has never been reported from Asia and as long as we do not know the spores of **P. infernalis**, the synonymy of the two species is not settled.

melanospilus, Polystictus (S).
Hedwgia 53:63,1913. Luzon, Laguna, Philippine Islands.
= **Pyrrhoderma scopulosus** (Berk.)Imaz.

moelleri, Polystictus (BPI).
Hedwigia 35;280,1896. Brazil.
= **Trametes pavonia** (Hook.) Ryv.

newtonii, Daedalea (BPI).
Bol. Soc. Brot. 7:169,1889. Ile de Thomas.
= **Cerrena meyenii** (Kl.) Hansen.

nigrescens, Poria (S).
Atti Accad. Sci. Lett. 3:83,1897. Hungary.
= **Rigidoporus crocatus** (Pat.) Ryv.

nigrescens, Trametes (S).
Ann Mycol. 3:163,1905. Bad Ratzej, Østerreich.
= **Datronia scutellata** (Schw.) Gilbn. & Ryv.

pachyderma, Fomes (BPI).
Hedwigia 51:311,1912. Mindanao,Philippine Islands.
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

pallidus, Polystictus (BPI).
Mycologia 17:73,1925. Brasil.
= **Trametes membranaceus** (Fr.) Kreisel.

pappianus, Fomes (FH,S).
Ann. Ins. Bot. Roma 6:178,1896. Farras-Kanukisce, Somalia.
= **Phellinus rimosus** (Berk.) Pil.

parvula, Trametes (FH). Fig. 3 D.
Ann. Mycol. :10, 506,1912. Tjibodas, Java, Indonesia.
= **Antrodia parvula** (Bres.) Ryv. comb nov. Basionym as cited above. Fruitbody effused reflexed, up to 1 cm wide

and 2 cm long, 3 mm thick, pileus cream, adpressed tomentose to glabrous in sulcate zones, pore surface cream, pores angular to round, 3-4 per mm, partly split on decurrent parts of pore surface, tubes concolorous, up to 2 mm deep, context pale cream, fibrous,1 mm thick. Hyphal system dimitic, generative hyphae with clamps, hyaline, 2-4 µm wide, skeletal hyphae hyaline, thick-walled, 3-5 µm wide, unbranched to rarely dichotomously branched, basidia clavate,15-2o x 4-6 µm with 4 sterigmata and basal clamp, cystidia not seen, basidiospores cylindric, hyaline , IKI-, 7-8 x3,5-4 µm. Causing a brown rot judged from the attached wood.
The species is placed in **Antrodia** owing to the dimitic hyphal system, the cylindric hyaline spores and the brown rot. Macroscopically it is reminicent of a small specimen of **A. albida** (Fr.) Donk, which, however, has larger fruitbodies, pores and spores.

pavonia, Poria (BPI,K,FH).
Hedwigia 35:282,1896. Brazil.
= **Grammothele subargentea** (Speg.) Rajch.

pfeifferi, Ganoderma (S).
Bull. Soc. myc. Fr. 5:70,1889. Frankfurt am Main,West Germany
Accepted in the genus, see Ryvarden 1976:169-170.

podlachius, Polyporus (S)
Ann. Mycol. 1:73,1903. Poland.
= **Polyporus varius Fr.**

porphyrophaea, Poria (NY).
Hedwigia 56:296,1915.Mindanao, Philippine Islands.
= **Rigidoporus vinctus** (Berk.) Ryv.

praetervisa, Trametes (S).
Ann. Mycol. 18:39,1920. Australia
= **Phaeotrametes decipiens** (Berk.) Wright.

proxima. Poria (BPI)
Mycologia 17:76,1925. Indiana,USA.
= **Oxyporus pellicula** (Jungh.) Ryv.

pruinata, Trametes (BPI).
Ann. Mycol. 18:39,1920. Brazil.
= **Daedalea microsticta** Cooke.

puberulus, Polystictus (BPI)
Ann. Mycol. 18:35,1920. Brazil.
= **Bjerkandera adusta** (Fr.) Karst.

pulchella, Trametes (BPI)
Stud. Trent. 2:58,1926. Tjibodas, Indonesia.
= **Grammothele pulchella** (Bres.) Ryv. comb. nov. Basionym as cited above.
This species was described earlier as **G. ochraceus** Ryv.

from Thailand, and for a description, see Hjortstam & Ryvarden 1982:275.

radiato-rugosa, Polystictus (S).
Ann. Mycol. 18:36,1920. Mozambique.
= **Trametes radiato-rugosus** (Bres.) Ryv. comb. nov. Basionym as cited above.
For a description, see Ryvarden & Johansen 1980:587, where it unfortunately was overlooked that Bresadola described his species in **Polystictus** and not in **Polyporus**. In the latter genus, the specific epithet is already occupied by **P. radiato-rugosus** Berk.

rancida, Poria (S).
Stud. Trent. 2:96,1900. Trident, Italy.
= **Oligoporus rancidus** (Bres.) Gilbn. & Ryv. For a description, see Gilbertson & Ryvarden 1987:482.

reichingeri, Fomes (S,NY) Fig. 3 E,F.
Denk. K. Akad.Wissensch. 85:179,1910. Buka Island, Samoa.
= **Phellinus reichingeri** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody perennial, applanate to ungulate, woody, up to 5 cm wide and thick, pileus glabrous, azonate, pale to dark brown and without a cuticle, pore surface dark brown, pores round, 4-6 per mm, tubes concolorous, context dark brown and dense, up to 3 cm thick.
Hyphal system dimitic, generative hyphae with simple septa, thin-walled, 2-3 µm wide, skeletal hyphae brown, thick-walled, unbranched, 3-5 µm wide, setae dark brown, slender, acute, 25-32 x 5-7 µm basidia not seen, basidiospores globose, 5-6 µm in diameter, hyaline to golden yellow.
This species reminds microscopically of **Phellinus weirianus** (Bres.) Gilbn. which however, in known only from Juglans in North America and where the setae are wider. The same is the case with **Phellinus setulosus** (Lloyd) Imaz. which also has larger spores.
With its glabrous pileus, slender setae and golden yellow spores, it should be easy to recognize. In the Beltsville Herbarium (BPI), there is a specimen from Australia:Queensland, Stewart River, leg. H. Muller.

renidens, Ganoderma (S)
Hedwigia 35:280,1896. Brazil.
= **Amauroderma renidens** (Bres.) Torr. For a description see Furtado 1981:69-70.

rensii, Poria (BPI)
Stud. Trent. 2:56,1926. Italy.
= **Gloeophyllum trabeum** (Fr.) Murr.

retirugis, Trametes (S)
Ann. Inst. Bot. Roma 5:177,1894. Somalia.
= **Polyporus retirugis** (Bres.) Ryv.. For a description, see Ryvarden & Johansen 1980:502.

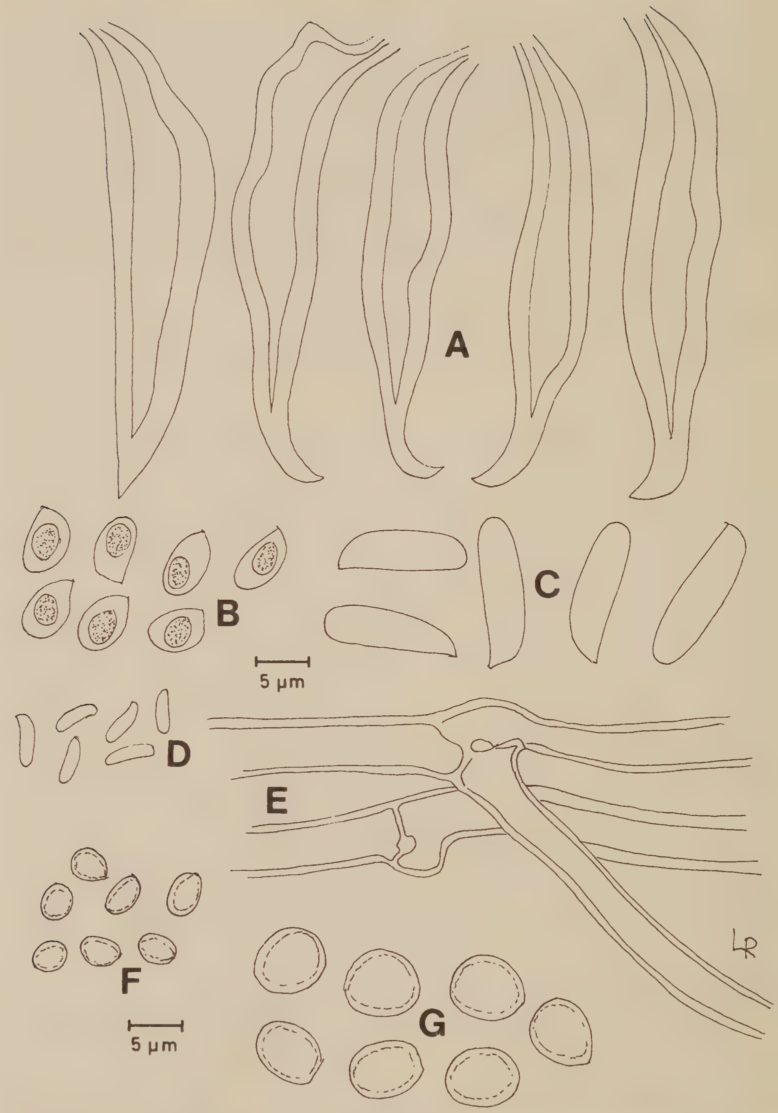

Fig. 4. **Phellinus rufus**: A) Setae, B) Spores. **Polyporus spegazzinianus**: C) Spores. **Tyromyces squamulosus**: D) Spores, E) Generative hyphae. **Perenniporia straminea**: F) Spores. **Perennipora straminella**: G) Spores. From the types.

revolutus, Polystictus (S)
Ann. Mycol. 18:35,1920. Trident, Italy.
= **Tyromyces cerifluus** (Berk. & Curt.) Murr.

rickianus, Polyporus (S)
Ann. Mycol. 18:33. 1920.
Nomen illegit.,non **P. rickianus** Sacc. & Trott.
The type is a specimen of **Aporpium substuppeus** (Berk. & Curt.) Rajchenb. For a description of this species, see Rajchenberg 1987:560.

rickii, Poria (BPI)
Ann. Mycol. 18:37,1920. Sao Leopoldo, Brazil.
= **Phellinus ferrugineo-velutinus** (Henn.) Ryv.

rubeolum, Ganoderma (S)
Mycologia 17:73,1925. Uganda.
=**Amauroderma preussii** (Henn.) Stey.

rufo-albus, Ptychogaster (FH).
Bull. Soc. mycol. Fr. 5:79,1889. Ile de Thome.
= **Ganoderma rufo-albus** (Bres. & Pat.) Pat.
The species belongs in the **G. lucidum**-complex, but there are smooth and golden brown gastrospores present in context, 7-12 µm in diameter. The status of the species will be settled when the **G. lucidum** complex is investigated on a world basis.

rubricosa, Trametes (BPI).
Mycologia 15:78,1925. New Mexico, USA.
= **Trichaptum byssogenus** (Jungh.) Ryv.

rufus, Fomes Fig. 4 A,B.
Ann. Mycol. 18:36,1936. Teneriffe, Canary Islands, Spain.
= **Phellinus rufus** (Bres.) Ryv. comb. nov.,basionym as cited above.
Fruitbody effused-reflexed to nodulose, pileus narrow, elongated up to 1 cm wide, 5 cm long, black, glabrous and sulcate, no cuticle visible, pore surface dark brown, pores round and thick-walled, 5-6 per mm, tubes up to 1 cm deep when measured vertically, concolorous with pore surface, context thin, dark brown and dense.
Hyphal system dimitic, generative hyphae with simple septa, hyaline, 1.5-3 µm in diameter, skeletal hyphae solid to thick-walled, yellowish brown, 3.5-5 µm wide, hymenial setae scattered and rare, straight to distinctly hooked at the apex, dark brown, 32-45 x 6.5-8 µm, basidia clavate, 12-14 x 6-7 µm with 4 sterigmata, basidiospores hyaline, oblong ellipsoid, IKI-, 5-6 x 4-4.5 µm.
This is a remarkable **Phellinus** species with a reflexed fruitbody, hooked setae and hyaline, ellipsoid spores. It should be easy to recognize, but I have never seen any report of a species with this combination of characters. Only a few species in the genus do have hooked setae, such as **Phellinus wahlbergii** (Fr.) Reid, but this is a tomentose, pileate species with smaller pores and spores.

salicina, Trametes (O).
Ann. Mycol. 18:40,1920. Asker, Norway.
= **Antrodia macra** (Sommerf.) Niem.
For a description of this species, see Niemelä 1985:38.

scaber, Polyporus (S)
Ann. Mycol. 18:34,1920.
= **Tyromyces subgiganteus** (Berk. & Curt.) Ryv.

schumannii, Polyporus Bull. Soc. mycol. Fr. 6:40,1890, Cameroon.
= **Antrodiella liebmannii** (Fr.) Ryv.

scruposa, Lenzites (BPI)
Ann. Mycol. 18:29,1920. Tjibodas, Java, Indonesia.
= **Gloeophyllum imponens** (Ces.) Parm.

sericea, var. **Trametes badia** (S)
Ann. Mycol. 18:40,1920. Brazil.
= **Coriolopsis badius** (Berk.) Murr.

similis, Trametes (S)
Ann. Mycol. 10:505,1912. Tjibodas, Java, Indonesia.
= **Antrodia parvula** (Bres.) Ryv.

similis, Poria (BPI)
Mycologia 17:76,1925. Idaho, USA.
= **Oxyporus similis** (Bres.) Ryv. For a description, see Gilbertson & Ryvarden 1987:500.

spadiceus, Polyporus (BPI)
Hedwigia 56:219,1915.
Nomen illegit. non **P. spadiceus** Schw. 1822, non Jungh. 1838, non Berkely 1839.

spegazzinianus, Polyporus (BPI) Fig. 4 C.
Ann. Mycol. 18:32,1920. Paraguay.
= Accepted in **Polyporus** s. str.
Fruitbody laterally stipitate, fanshaped to dimidiate, umbilicate, 2-3 cm wide, fragile when dry, pileus glabrous, smooth, azonate and deep bay, margin curved in dry condition, pore surface ochraceous, pores angular to hexagonal, slightly elongated towards the stipe attachment, appr. 0.5-1 x 1-2 mm, tubes up to 1 mm deep, context ochraceous, very thin.
Hyphal system dimitic, generative hyphae with clamps, hyaline, 2-5 µm wide, binding hyphae of the Bovista type, solid, hyaline, moderately branched, up to 7 µm wide in the main trunk.
Basidia clavate with 4 sterigmata and basal clamp, 22-30 x 5-6 µm. Basidiospores cylindrical to allantoid, hyaline, IKI-, 11.5-14.5 x 3.5-4 µm. On hardwood log.
The species should be very easy to recognize by the glabrous and deep bay pileus of a stipitate fruitbody and above all by the large cylindrical to almost allantoid spores.

spegazzinii, Lenzites (BPI,S)
Stud. Trent. 2:53,1926. La Plata, Argentine.
= **Trametes elegans** (Fr.) Fr.

squamulosus, Polyporus (S) Fig. 4 D,E.
Bull. Soc. mycol. Fr. 6:39,1890. Ile St. Thomas.
= **Tyromyces squamulosus** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody pileate, annual, dimidiate, 8 cm wide, broad, up to 2 cm thick, pileus finely squamulose, grey to yellow, azonate, pore surface white to cream, pores round, 5-7 per mm, tubes white, brittle, context fibrous white, up to 8 mm thick.
Hyphal system monomitic, generative hyphae with large clamps, thick to thin-walled, 3-7 µm wide. Basidia clavate with 4 sterigmata and basal clamp,10-14 x 4-5 µm. Basidiospores allantoid, hyaline, 3.5-5 x 1.5 µm, IKI-.

straminea, Poria (BPI) Fig. 4 F.
Hedwigia 51:316,1912. Negros, Philippine Islands.
= **Perenniporia straminea** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody resupinate, adnate, rather small, 2 x 4 cm, hard and semicartilaginous as dry, pore surface straw-coloured as fresh (teste Bresadola), isabelline when dry, pores hardly visible to the naked eye, 7-9 per mm, tubes concolorous, up to 2 mm deep, context very thin, ochraceous to isabelline. Hyphal system dimitic, generative hyphae with clamps, difficult to observe, 2-3 µm wide, skeletal hyphae dominating, solid, 2-4 µm wide. Spores subglobose to truncate, slightly thick-walled and dextrinoid 3-4 x 2.5-3 µm.
David & Rajchenberg 1985:294 as well as Bresadola op. cit. himself suggested that **Perenniporia** would be a proper genus for this species due to the truncate and slightly dextrinoid spores. They are much smaller than known otherwise in the genus.

straminellus, Polyporus (BPI) Fig. 4 G.
Ann. Mycol. 18:32,1920. Java.
= **Perenniporia straminella** (Bres.) Ryv. comb. nov. Basionym as cited above.
Fruitbody pileate, dimidiate to fanshaped with strongly contracted base, coriaceous, up to 3 cm wide and broad,1-3 cm thick, pileus glabrous to pale straw-coloured, slightly radially striate to wrinkled and slightly zonate, pores surface straw-coloured, pores angular,1-2 per mm, tubes up to 1 mm deep, context cream,1 mm thick.
Hyphal system dimitic, generative hyphae with clamps, hyaline, 2-3 µm wide, skeletal hyphae dominating, twisted, sinuous, solid, strongly dextrinoid, 2-5(7) µm in diam. Basidia and cystida not seen. Basidiospores globose, thick-walled, 5-6 µm in diam.,slightly dextrinoid.
The species is characterized by the small dimidiate fruitbody with large pores and the globose spores.

subambigua, Poria (BPI)
Ann. Mycol. 9:268,1911. Kisantu, Zaire.
= **Ceriporia xylostromatoides** (Berk.) Ryv.

subannosus, Fomes (BPI)
Stud. Trent. 2:55,1926. San Leopoldo, Brazil.
= **Perenniporia contraria** (Berk. & Curt.) Ryv.

subcapucinus, Polyporus (BPI)
Mycologia 17:74,1925. Brazil.
= **Phylloporia weberiana** Bres. & Henn.

subcervina, Trametes (BPI)
Mycologia 17:74,1925. Brazil.
= **Antrodia albida** (Fr.) Donk.

subendothejus, Fomes (BPI)
Ann. Mycol. 8:589,1910. Curacao, New Guinea.
= **Phellinus rimosus** (Berk.) Pil.

subgilvus, Polyporus (BPI)
Ann. Mycol. 18:34,1920. Curacao, New Guinea.
= **Phellinus gilvus** (Schw.) Pat.

subpruinatus, Polyporus (FH)
Ann. Mycol. 10:495,1912. Tjibodas, Indonesia.
= **Coriolopsis sanguinaria** (Kl.) Teng

subradiatus, Polyporus (BPI)
Engl. Bot. Jahrb. 54:247,1916. New Guinea.
= **Phellinus gilvus** (Schw.) Pat.

subrugosum, Ganoderma Bres. & Pat. (BPI,S)
Bull. Soc. mycol. Fr. 5:77,1889. Samoa
= **Amauroderma subrugosum** (Bres. & Pat.) Torr. For a description see Furtado 1981:91.

subsinuosa, Trametes (BPI)
Ann. Mycol.1:82,1903. Poland
= **Antrodia ramentacea** (Berk. & Br.) Donk.

subtestaceus, Polyporus (S)
Ann. Mycol. 3:162,1905. Hungary
= **Hapalopilus croceus** (Fr.) Donk.

surinamensis, Fomes (BPI)
Ann. Mycol. 8:588,1910. Surinam
= **Phellinus rhytiphloeus** (Mont.) Ryv.

testaceo-fuscus, Fomes (BPI)
Ann. Mycol. 10:498,1912. Tjibodas, Inodonesia.
= **Phellinus adamantinus** (Berk.) Ryv.

tricolor, Poria (S)
Hedwigia 51:316,1912. Negros, Philippine Islands.
= **Phellinus tricolor** (Bres.) Kotl. For a description, see

Ryvarden & Johansen 1980:223.

torrendii, Poria (BPI)
Ann. Mycol. 18:37,1920. Brazil
= **Phellinus umbrinella** (Bres.) Ryv.

triviale, Ganoderma (FH)
Ann. Mycol. 10:501,1912. Buitenzorg, Indonesia.
= **Ganoderma subfornicatum** Murr., as indicated by Steyaert 1967:160.

tuberculata, Trametes (S)
Ann. Mycol. 10:505,1912. Tjibodas, Indonesia.
= **Daedalea incana** (Lév.) Ryv.

tumidum, Ganoderma (BPI)
Ann. Mycol. 9:267,1911. Kisantu, Zaire.
= **Ganoderma zonatum** Murr., as indicated by Steyaert 1967:473.

umbrina, Hexagonia (BPI)
Hedwigia 56:298,1915. Luzon, Philippine Islands.
= **Datronia brunnea-leuca** (Berk.) Ryv.

umbrinella, Poria (S)
Hedwigia 35:282,1896.
= **Phellinus umbrinella** (Bres.) Ryv., for a description, see Ryvarden & Johansen 1980:224.

umbrinellus, Polystictus (S)
Ann. Mycol. 5:239,1907. Java, Inodonesia.
= **Favolaschia** sp.

umbrinum, Ganoderma (BPI)
Ann. Mycol. 10:501,1912. Java, Indonesia.
= **Ganoderma cfr. zonatum** Murr.

umbrinus, Polystictus (BPI)
Hedwigia 51:315,1912. Magellenes, Philippine Islands.
= **Datronia caperata** (Berk.) Ryv.

validus, Fomes (BPI)
Hedwigia 56:294,1915. Luzon, Philippine Islands.
= **Phellinus nilgheriensis** (Mont.) Cunn.

velutinus, Fomes (S)
Ann. Mycol. 10:498,1912. Tjibodas, Indonesia.
= **Phellinus extensus** (Lév.) Pat.

versicolor, Fomes (S)
Bull. Jard. Bot. Brux. 8:91,1921. Zaire.
= **Amauroderma preussii** (Henn.) Stey.

vicina, Poria (BPI)
Mycologia 17:76,1925. Idaho, USA.
= **Oxyporus corticola** (Fr.) Ryv.

vicinus, Polystictus (BPI)
Ann. Mycol. 18:35,1920. San Leopoldo, Brazil
= **Trametes** cfr. **ochroflava** Cooke, the type is sterile.

weirianus, Fomes (BPI)
Stud. Trent. 2:55,1926. New Mexico, USA.
= **Phellinus weirianus** (Bres.) Gilbn. For a description, see Gilbertson & Ryvarden 1987:620.

wildemanii, Hexagonia (S)
Ann. Mycol. 9:269,1911. Kisanti, Zaire.
= **Coriolopsis telfarii** (Kl.) Ryv.

zimmermanni, Trametes (S)
Ann. Mycol. 18:38,1920. Usambara, Tanzania.
= **Earliella scabrosa** (Pers.) Gilbn. & Ryv.

zonata, Poria (S)
Mycologia 17:77,1925. Idaho, USA.
= **Junghuhnia zonata** (Bres.) Ryv. For a description, see Gilbertson & Ryvarden 1986:419.

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ADDITIONS TO CONDYLOSPORA (HYPHOMYCETES) FROM MALAYSIA

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Two new taxa are described in **Condylospora: C.flexuosa** sp.nov. and **C.gigantea** sp.nov. found on submerged decaying twigs. The type species **C.spumigena** is illustrated from its natural substrate. Conidia of an unidentified **Condylospora** sp. from samples are also illustrated. A key to the known species is also provided.

The genus **Condylospora** was introduced by Nawawi (1976) to accomodate a species of hyphomycete with hyaline, worm-like, multi-septate conidia with a characteristic elbow-shaped bend near the middle. Conidia are borne on sympodially proliferating conidiogenous cells with cylindrical, truncate, thin-walled, unpigmented denticles. The type species **C.spumigena** Nawawi was described from cultures derived from a single conidium found in a foam sample. In terms of spore morphology, size and septation (where given) those depicted earlier by Tubaki (1960,Fig.2A; 1965,Pl 1D) from Japan and Papua New Guinea respectively, Miura (1974, Fig.44) from Japan, Ingold and Webster (1973, Fig.4C) from India and Matsushima (1975,Pl363, Fig.2) from Japan undoubtedly belong to **C.spumigena.** The fungus, therefore, appears to be common and widespread. In addition, other spore-types belonging to **Condylospora** are also present in foam samples from freshwater streams in Malaysia. Two of these spore-types have already been recorded by Nawawi (1985,Figs.13 & 80).

Recent collections of submerged decaying twigs from Malaysian freshwater streams subsequently incubated in moist chambers have yielded **C.spumigena** and two undescribed species of **Condylospora.**

Condylospora flexuosa sp.nov. (Figs. 1 – 2)

Coloniae effusae, pruinosae, albidae, siccae vix visibiles. Mycelium plerumque superficiale ex hyphis laevibus, ramosis,

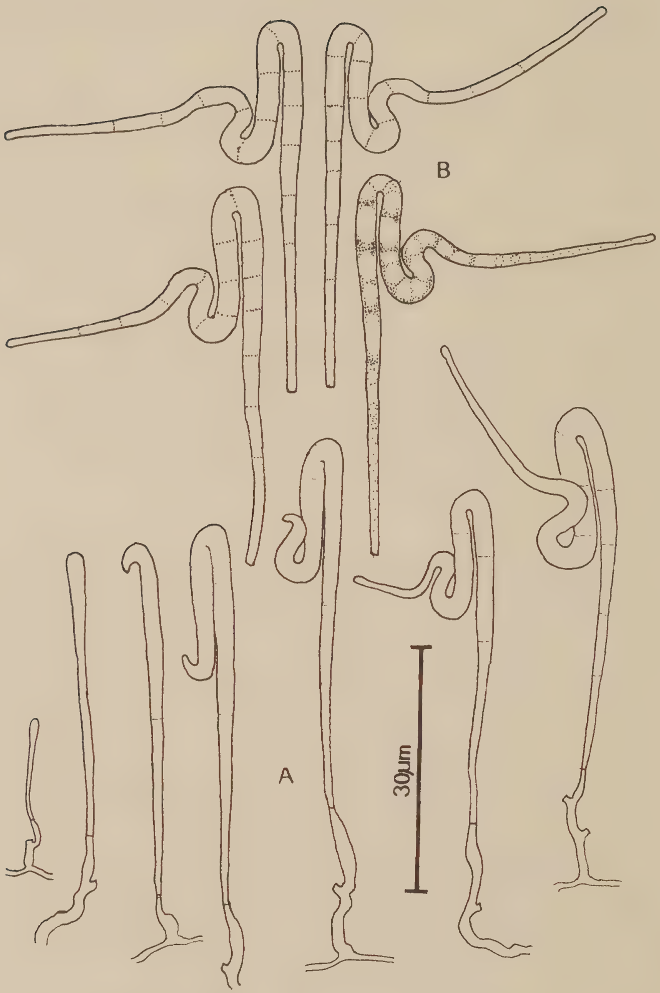
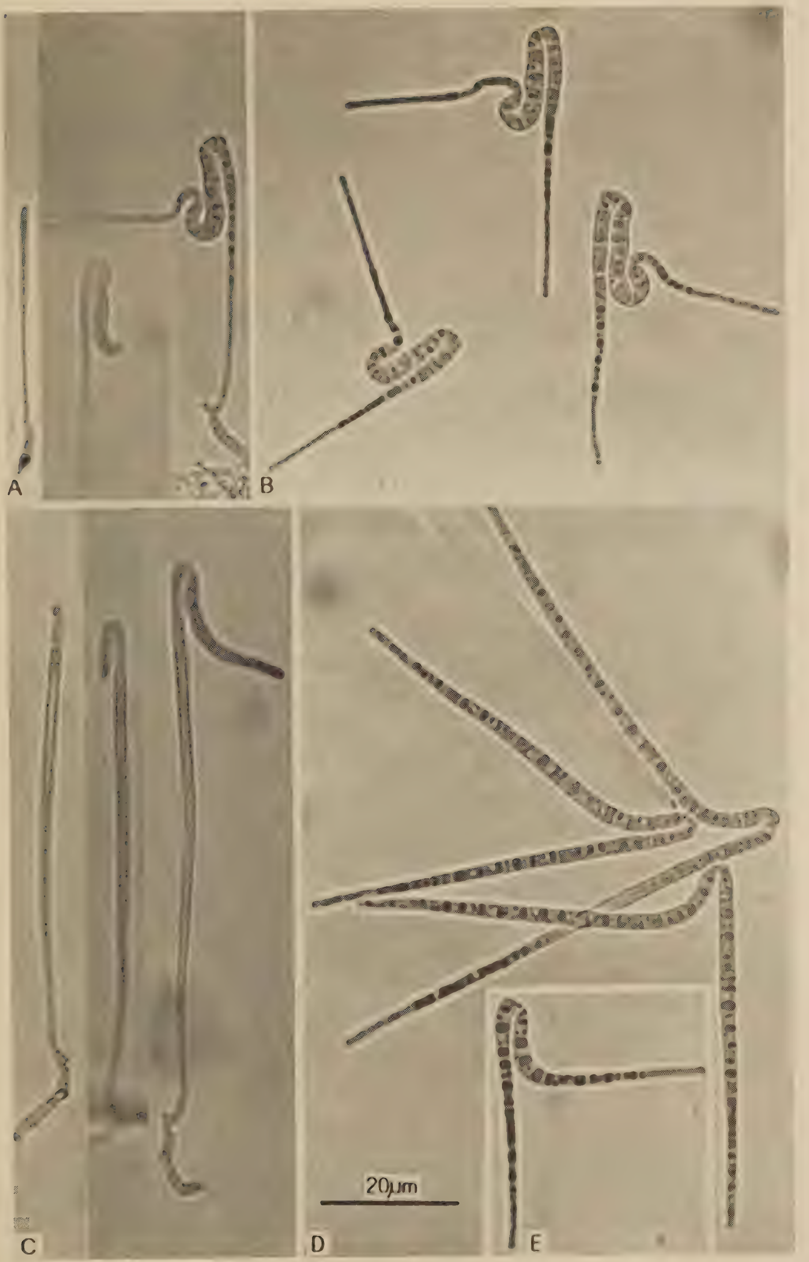


Fig.1. **Condylospora flexuosa.** (A) Conidiophores with conidia at various stages of development arranged in a developmental series; (B) typical conidia.

Fig.2. **Condylospora flexuosa.** (A) Conidiophores bearing conidia at various stages of development; (B) typical conidia; **C.gigantea** (C) Conidiophores with developing conidia; (D) typical conidia; **C.spumigena** (E) a conidium for comparison.


A
B
C
D
E
20µm

septatis, hyalinis, 1 – 1.5 μm latis compositum. Conidiophora ex hyphis crescentia, micronematosa vel semi-macronematosa, praecipue lateralia, primo brevia, simplicia, cylindrica, denticulata, sympodialiter prolificantia. Conidia acrogena, solitaria deim acropleurogena, vermicularia, hyalina cum parietibus tenuibus 12 – 16 septata, tris flexa circa medium; pars proximalis clavata, recta vel subcurvata 43 – 49 μm longa x 1 – 1.5 μm lata ad basim, cicatrix truncata, in loco latissimo 2.5 – 3 μm, paulum constricta ad 2 μm ad flexum, pars distalis 35 – 38 μm longa, attenuata ad 1.5 μm ad apicem.

Ex ramulum putridum in flumine immersi, Gunung Jerai, Kedah, Malaysia, A. Nawawi, 26 Feb. 1988, IMI 323238 holotypus.

Colonies on the host effuse, dewy, whitish, when dried scarcely visible. Mycelium mostly superficial consisting of smooth, branched, septate, hyaline 1 – 1.5 μm wide hyphae. Conidiophores arising as erect lateral branches from the vegetative hyphae, at first short, simple, slightly broader than the vegetative hyphae. With progressing conidiogenesis the conidiophores elongate considerably to become flexuous with short, truncate cylindrical unthickened denticles up to 2.5 μm long x 0.5 μm wide.

Conidium development from submerged twig begins with the production of a narrow, straight, club-like primordium separated from the conidiophore by a basal septum. When about 42 – 48 μm long the tip folds over and continues to grow in a downward direction, more or less parallel to the proximal portion. When it reaches 10 – 20 μm long the tip bends upward, grows into an S-shaped part and finally straightens out to varying degree. Septa are laid down at intervals along the developing conidium, but they are not very distinct in young conidia. Conidial secession is schizolytic by the disarticulation of the basal septum. Mature conidia are hyaline, thin-walled, guttulate, cylindrical, 12 – 16 septate, consisting of a straight to slightly curved proximal portion 43 – 49 μm long with a truncate base 1 – 1.5 μm wide, broadening to 2.5 – 3 μm above. The distance between the first and the second bend is 16 – 20 μm long, while the distal portion (measured from the base of the S-bend to the tip) is 35 – 38 μm long and forming an angle of 75° – 120° with the proximal part. All parts of the conidium lie in one plane.

Conidia germinate very slowly on agar media by producing germ-tubes from the tips. On CMA a single spore colony becomes visible only after 17 days at 25 – 28°C. Five weeks old colonies average 5 mm in diam. Colonies are white, smooth, slightly raised, compact, in the centre. With age the centre turns brownish.

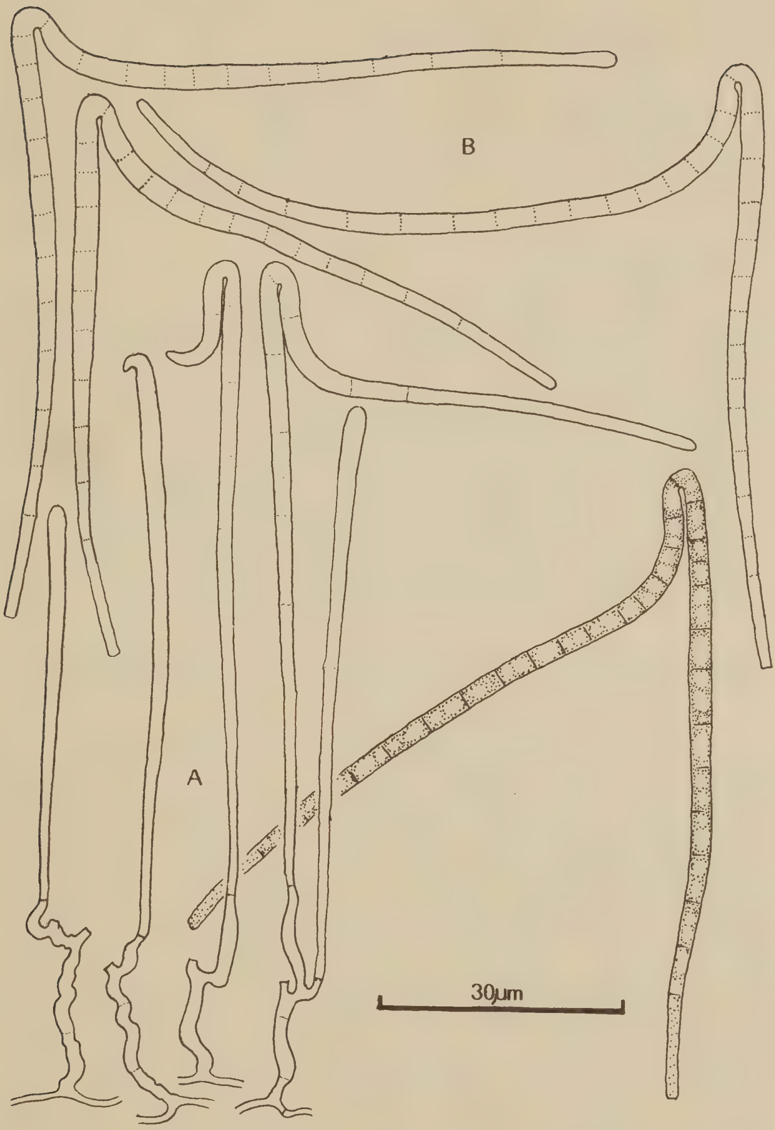


Fig.3. **Condylospora gigantea.** (A) Stages in conidial formation; (B) typical conidia.

Hyphae are of irregular width and often beaded. No sporulation occurred on dry or submerged agar.

C.flexuosa is similar to **C.spumigena** in its conidiogenesis and conidium size. Conidia of **C.flexuosa**, however, possess an S-shaped bend at the base of the distal part which make them distinct and readily distinguished from all other members of the genus.

Condylospora gigantea sp.nov. (Figs. 2 – 3)

Coloniae expansae, pruinosae, albidae, siccae vix visibiles. Mycelium plerumque superficiale ex hyphis laevibus, ramosis, septatis, hyalinis, 1.5 – 2 µm latis compositum. Conidiophora ex hyphis crescentia, semi-macronematosa, praecipue lateralia, ascendentia ad erecta, saepe flexuosa, 11 – 28 µm longa x 1.5 – 2 µm lata; cylindrica, denticulata, mox geniculata, sympodialiter prolificantes. Conidia crescentia singulatum ex apicibus cellularum conidiogenarum, vermicularia, hyalina, cum parietibus tenuibus, 25 – 36 septata, bis flexa circa medium; pars proximalis 66 – 95 µm longa x 1.5 µm lata ad basim, in loco latissimo 2.5 – 3 µm, paulum constricta ad 1.5 µm ad flexum; pars distalis 64 – 105 µm, attenuata ad 1.5 µm ad apicem, secedentia schizolytice.

Ex ramulum putridum in flumine immersi, Gunung Jerai, Kedah, Malaysia, A. Nawawi, 26 Feb. 1988, IMI 323238 holotypus.

Colonies on moist twig expanding, dewy, whitish, when dried scarcely visible. Mycelium mostly superficial consisting of smooth, branched, septate, hyaline 1.5 – 2 µm wide hyphae. Conidiophores arising as ascending to erect lateral branches from the vegetative hyphae, at first short, simple, semi-macronematous, cylindrical, flexuous, 11 – 28 µm long x 1.5 – 2 µm wide, thin-walled, provided with up to 5 cylindrical, conidium-bearing denticles 1 – 2 µm in length, scars unthickened about 0.5 µm wide. Conidia single, acropleurogenous, hyaline, thin-walled, cylindrical, worm-like, 25 – 36 septate, bent backward on themselves just about the half-way mark and again a short distance away; all parts lying in the same plane. The proximal portion of the conidium is straight to slightly curved, 66 – 95 µm long x 1.5 µm wide at the truncate base, broadening above to 2.5 – 3 µm. It constricts slightly to about 1.5 µm at the elbow-bend. The distal portion (measured from the top of the bend to the tip) is usually longer measuring 64 – 105 µm long, narrowing to 1.5 µm at the obtuse apex and forming an angle of 60 – 90° with the proximal part. Conidia secede schizolytically.

Conidia germinate quite readily on agar media by producing

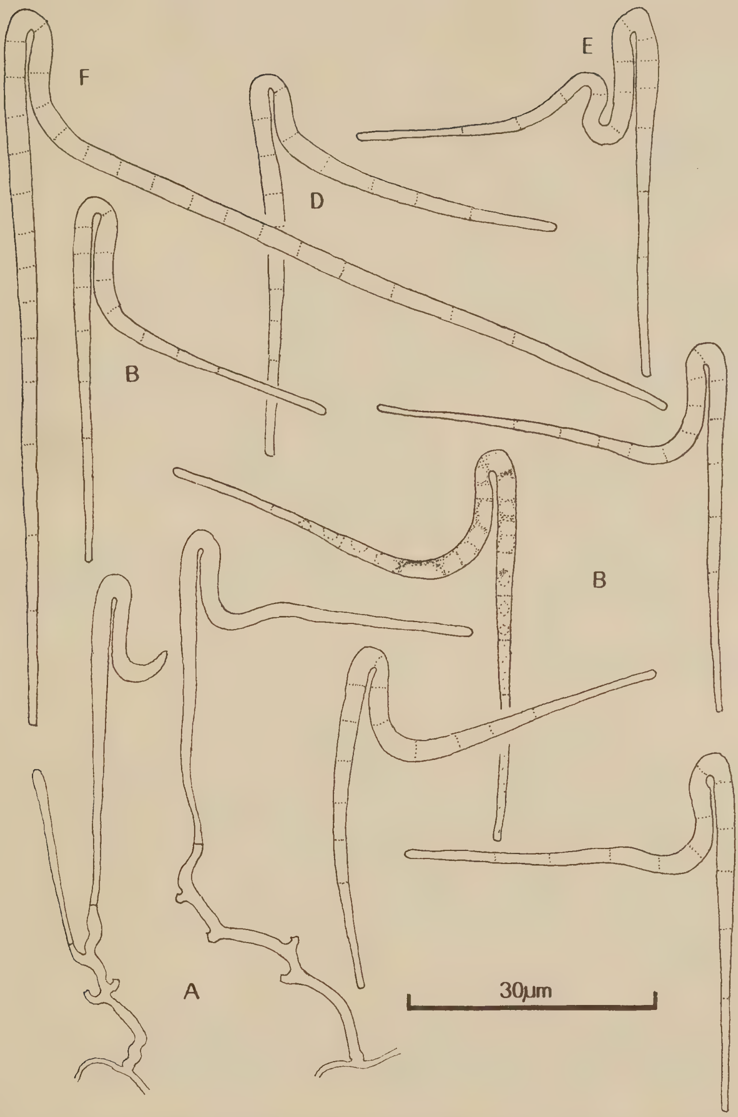


Fig.4. **Condylospora spumigena.** (A) Stages in conidial formation; (B) typical conidia (IMI 323237); (D) a conidium from the type specimen (IMI 193708); (E – F) a conidium of **C.flexuosa** and **C.gigantea** respectively for comparison.

germ-tubes from the apices and along the length of the conidia. Colonies on CMA at 25 – 28°C attaining about 7 mm in 5 weeks, white, appressed, smooth, shiny, with a regular sharp margin. Hyphae hyaline, 1 – 2 µm wide, mostly beaded and irregularly branched. The colony remains white with age, thus differing from **C.spumigena** and **C.flexuosa.** Of the three species described **C.gigantea** has slightly faster growth rates. As with the other species the colonies remain sterile even when flooded or submerged in water.

C.gigantea agrees well with the type species in the ontogeny and morphology of its conidia. At a glance it is quite difficult to distinguish their conidia unless both species are examined together. Indeed, all conidia encountered previously in foam samples were identified as belonging to **C.spumigena.** The main difference lies in the size of their conidia. Those of **C.gigantea** are about twice as long, broader and up to 36 septate. The proximal and distal parts measure 66 – 95 µm and 64 – 105 µm long respectively in **C.gigantea,** while the corresponding length in **C.spumigena** are 44 – 50 µm and 39 – 45 µm.

Other specimen examined: On submerged unidentified decaying twig, Bukit Renggit, Pahang, Malaysia, A. Nawawi, 19 Oct. 1987.

Condylospora spumigena Nawawi, **Trans. Br. mycol. Soc. 66:**363 (1976) (Fig. 4)

Colonies on the natural substrate dewy, forming thin, white patches. Conidiophores single, ascending to erect, semi-macronematous, short at first, but becoming longer with progressing conidiogenesis, rachis meander-like, up to 52 µm long with short, cylindrical, truncate denticles 1.5 – 2 µm long x 0.5 µm wide. Up to 10 denticles have been observed on a conidiophore. Conidia hyaline, thin-walled, guttulate, with the proximal part measuring 45– 50 µm long x 1 µm at the base, broadening to 2 – 2.5 µm above. The distal part measures 39 – 45 µm long.

Colonies on CMA at 25– 28° C attaining 6 mm diam in 5 weeks, white, smooth, shiny with the middle area turning light brown with age. Colonies remain restricted and sterile.

Specimen examined: On submerged unidentified decaying twig, Gunung Jerai, Kedah, Malaysia, A. Nawawi, 26 Feb. 1988, IMI 323237.

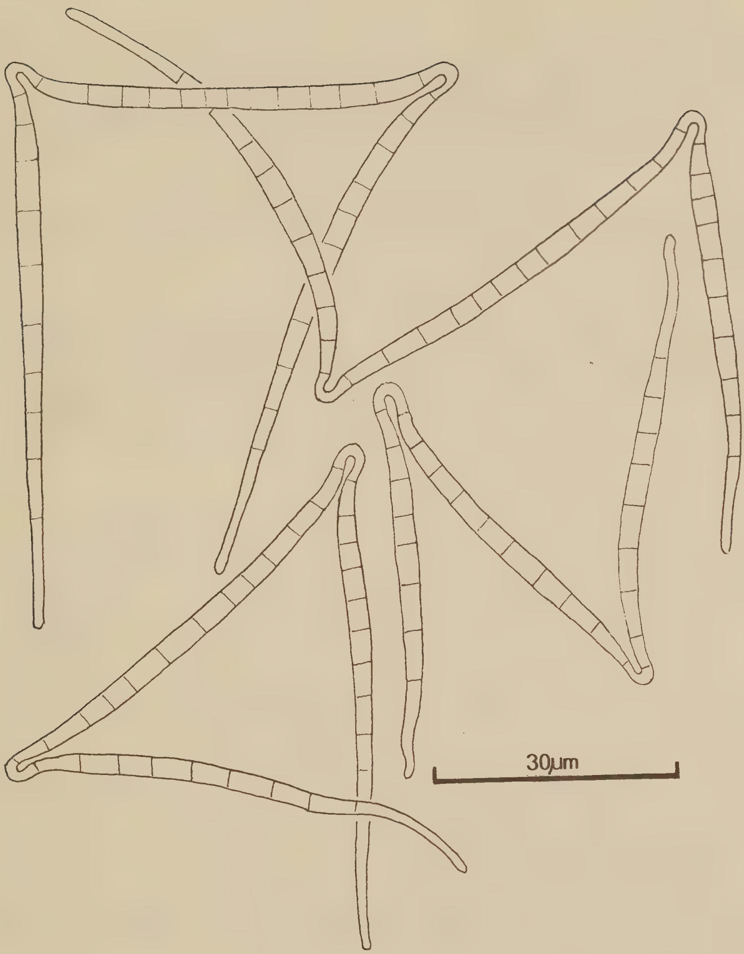


Fig.5. **Condylospora** sp. Four conidia found in foam samples.

Condylospora sp. (Fig. 5)

Figure 5 illustrates several conidia of a **Condylospora** sp. They are of frequent occurrence in foam samples collected from Malaysian freshwater streams, though not in abundance. Most are N-shaped but they may assume other configurations depending on the disposition of the distal part. Conidia are hyaline, 27 – 42 septate, guttulate and consists of three parts. The proximal and distal parts are indistinguishable, straight to slightly curved, lying in the same or different planes, 55 – 74 µm long x 2.5 – 3 µm wide, narrowing to about 1.5 µm at the apices. The middle part measures 50 – 60 µm long.

Conidia germinate on agar media with difficulty, producing germ-tubes from the apices. On CMA the colonies are slow-growing, restricted, white and compact, very similar to **C.spumigena.** No sporulation occurred on dry or submerged agar.

KEY TO **CONDYLOSPORA** SPECIES

1. Conidia with one incurved bend about the middle . . 2
1. Conidia with two, almost equally spaced incurved bends, mostly N-shaped . . . . **Condylospora** sp.
1. Conidia with three bends about the middle . . **C.flexuosa**
    2. Proximal part of conidia 44-50 µm long . . **C.spumigena**
    2. Proximal part of conidia 66-95 µm long . . **C.gigantea**

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STUDIES IN THE GENUS PHOMA. XV. CONCERNING PHOMA MULTIROSTRATA, A LEAF SPOT-INDUCING AND SOIL-BORNE SPECIES IN WARM CLIMATES.

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ABSTRACT

Phoma multirostrata (Mathur, Menon & Thirum.) Dorenbosch & Boerema is described and illustrated from isolates obtained from cucumber, soybean and cysts of the soybean cyst nematode. An account is given of its nomenclatural history as well as its cultural characteristics, morphology, and the anatomy of its pycnidial wall.

INTRODUCTION

The fungus presently known as *Phoma multirostrata*, although described comparatively recently, has suffered the fate of many *Phoma* species known since the last century. It has been given a number of binomials based predominantly on substrate association or imagined rather than real, intrinsic morphological distinctions. Lack of critical evaluation with reference to the literature and a propensity for naming new species has also been, in part, responsible for this state of affairs. It was first given the name *Sphaeronaema multirostratum* [as '*Sphaeronema multirostrata*'] by Mathur, Menon & Thirumalachar [in Mathur and Thirumalachar (1959)]. It had been isolated from soil collected at Talegaon, Poona, India, and was assigned to *Sphaeronaema* Fr. rather than *Phoma* Sacc., presumably because of the presence of beaked pycnidia. No mention was made, however, of generic distinctions in this paper that also included descriptions of a second new species of *Sphaeronaema*, *S. indicum* [as '*Sphaeronema indica*'] Mathur, Menon & Thirum., and a new species of *Phoma*, *P. pimprina* Mathur, Menon & Thirum., both also originating from soil. Judging from the published description, although it contains a contradiction concerning colony growth rate, it appears that the fungus given the name *P. pimprina* may have been *P. herbarum* Westd. The fungus was described as having no aerial mycelium when grown on Czapek's agar and producing numerous, distinctly ostiolate pycnidia superficially, from which conidial masses extrude and encrust on the colony surface. These are all characteristics of *P. herbarum* (see Morgan-Jones, 1988). In one place in the original description, *P. pimprina* was said to grow rapidly on Czapek's agar but, in a succeeding paragraph, colonies were described as being "on Czapek's agar slow growing". Colonies of *P. herbarum* are generally slow-growing. Pycnidia of *Sphaeronaema multirostratum* were described as being gregarious, superficial or immersed, enveloped by fumaceous mycelium, and to produce one

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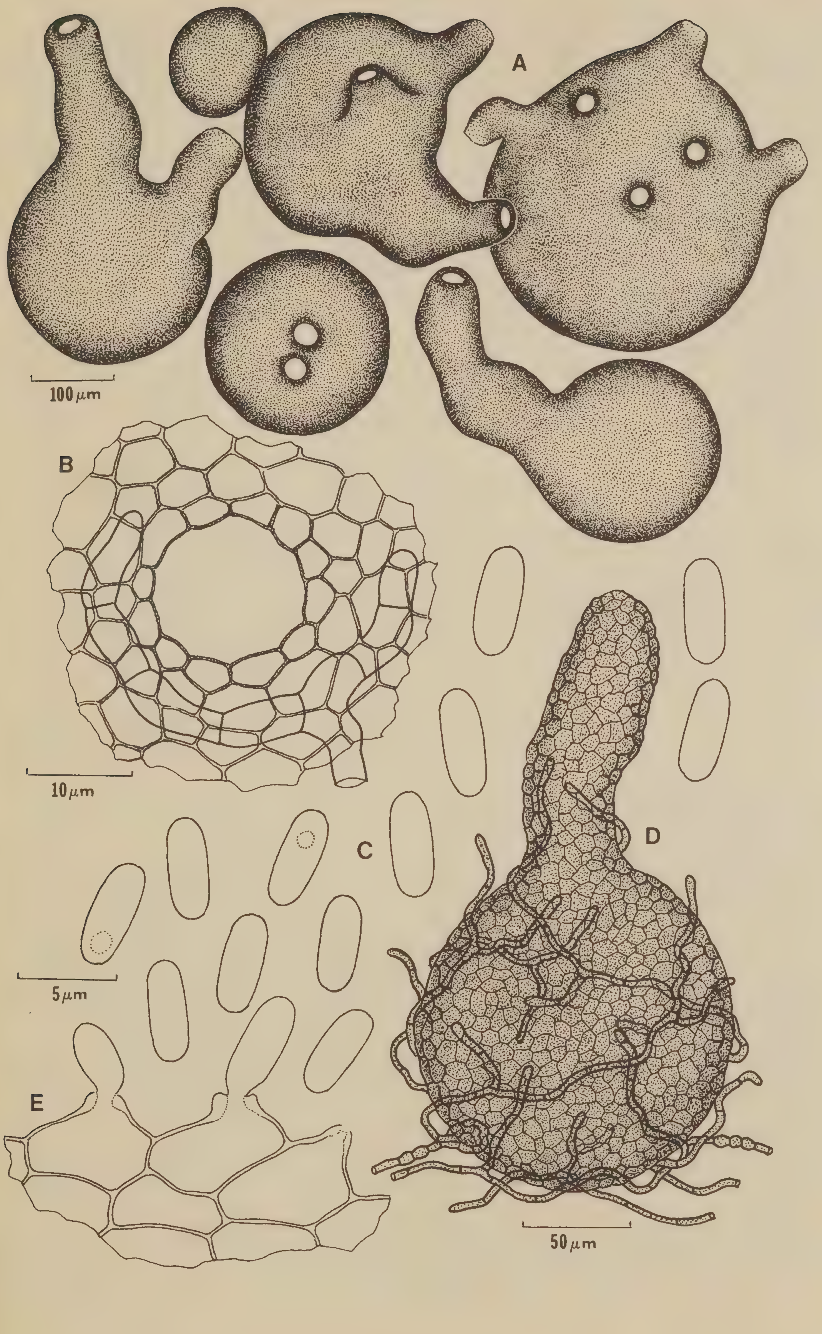
to three protruding, upturned, often curved, beak-like structures, each opening by a pore. No mention was made of any chlamydospores. In addition to the type culture of *S. multirostrata*, M.J. Thirumalachar deposited at the Centraalbureau voor Schimmelcultures two other isolates under the names *Sphaeronaema multirostratum* var. *macrospora* Mathur & Thirum. and *Sphaeronaema roseum* Mathur & Thirum., both *nomina nuda*. Dorenbosch & Boerema (1973), following examination of the three isolates, concluded that they were of the same fungus and that it belonged to the form-genus *Phoma*. They accordingly transferred it to that genus as *P. multirostrata* and, in addition, recognized that several binomials established during the 1960's were based on the same entity.

Dorenbosch and Höweler (1968) had earlier determined that *Phoma liliana* Chandra & Tandon, described from leaf spots of a *Lilium* species (Chandra and Tandon, 1965), and *Phoma ehretiae* Chandra and Tandon, described from leaf spots of *Ehretia acuminata* R. Br. (Chandra and Tandon, 1966), were conspecific. The pycnidia of the latter were originally described as being globose, subglobose or oblong, sparsely covered with dark brown hyphae and with an indistinct, non-papillate ostiole (Chandra and Tandon, 1965). The type isolates of both *P. liliana* and *P. ehretiae*, originating from material collected in the botanical garden of the University of Allahabad, India, were examined by Dorenbosch and Höweler. In addition, they recognized that a *Phoma* species, received at the Centraalbureau voor Schimmelcultures, from roots of *Mangifera indica* L. in Mali, Africa, was identical. Likewise, a *Phoma* isolate from *Chrysanthemum* cuttings originating in Le Muy in southern France was found to be the same fungus. All four isolates were reported to have a colony growth pattern approximating that of *Phoma medicaginis* Malbr. & Roum., but to differ from that species morphologically by producing pycnidia with long necks. Chlamydospores were reported to be present occasionally in every isolate. The binomial *Phoma liliana* was, by date priority, taken up for the fungus.

Dorenbosch and Boerema (1973), following a comparison of their respective type isolates, determined the names *P. liliana* and *S. multirostratum* to be based on the same fungus. In addition, examination of the type culture of *Phoma terrestris* [as '*P. terrestre*'] Saksena, Nand & Sarbhoy (1966) [non *Phoma terrestris* Hansen (1929)], from soil at Unnao, Lucknow, India, revealed it also to be identical. Saksena *et al.* (1968) realizing, through information provided by F.C. Deighton, their *Phoma terrestris* to be a later homonym of *Phoma terrestris* Hansen, proposed a *nomen novum*, *Phoma lucknowensis* Saksena, Nand & Sarbhoy to replace it. In their description of *P. lucknowensis* (as *P. terrestre*) Saksena *et al.* (1966) noted the presence of chlamydospores and, although the pycnidia were said to be globose to subglobose, two so-called pycnidium types were illustrated, one distinctly rostrate. [Reference in their Latin diagnosis to the effect that chlamydospores were absent, whereas in their English description they were said to be present, is presumed to have been an error.] The pycnidia were found to be surrounded by brown hyphae. To justify the naming of a new species, Saksena *et al.* stated that their isolate came nearest *Phoma asparagi* Sacc. in conidial size but differed from it in size and shape of pycnidia and in producing pycnidia arranged in a zone. *Phoma lucknowensis* Agarwal & Misra [*Curr. Sci.* 50: 600, 1981] is, incidentally, a later homonym of *P. lucknowensis* Saksena, Nand & Sarbhoy.

FIGURE 1. *Phoma multirostrata*. A, pycnidial shapes; B, surface view of pycnidial wall cells surrounding ostiole; C, conidia; D, rostrate pycnidium surrounded by hyphal network; E, conidiogenous cells.


A
100 μm
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5 μm
D
50 μm
E

Thus, in the space of just under a decade, a single fungus was given, not counting *nomina nuda*, five different binomials by mycologists working in the same country. Four of the names were established by individuals working out of the same institution and publishing mostly in the same journal! All this in spite of the fact that each entity to which names were applied had been studied *in vitro*. In the past, where *Phoma* species were known only *in vivo*, species concepts were, perhaps understandably, unduly tied to host relationships partly because some other distinctions between taxa were not readily apparent without isolation in pure culture. Critical comparison of available cultures and caution in establishing names with slender justification should, in the case of *P. multirostrata*, have avoided the proliferation of binomials for a single entity.

During the course of conducting a survey of opportunistic soil fungi colonizing cysts of *Heterodera glycines* Ichinohe in an Alabama soybean field soil (Morgan-Jones and Rodriguez-Kabana, 1981), *P. multirostrata* was encountered on several occasions and isolated in pure culture. I have also, through the good offices of Dr. M.E. Noordeloos, had opportunity to examine two other isolates of the fungus one originating in Jamaica, the other from The Netherlands.

TAXONOMIC PART

Phoma multirostrata (Mathur, Menon & Thirum.) Dorenbosch & Boerema, *Mycopath. Mycol. Appl.* 50: 256, 1973 (Plates 1, 2 & 3, figures 1 & 2).

≡ *Sphaeronaema multirostratum* Mathur, Menon & Thirum., *Sydowia* 13: 146, 1959.

= *Phoma liliana* Chandra & Tandon, *Curr. Sci.* 31: 566, 1965.

= *Phoma terrestris* Saksena, Nand & Sarbhoy, *Mycopath. Mycol. Appl.* 29: 86, 1966 [non *Phoma terrestris* Hansen, *Phytopathology* 19: 699, 1929].

= *Phoma ehretiae* Chandra & Tandon, *Mycopath. Mycol. Appl.* 29: 276, 1966.

= *Phoma lucknowensis* Saksena, Nand & Sarbhoy, *Mycopath. Mycol. Appl.* 34: 93, 1968.

Colonies on PDA [Difco] (Plate 1, A & C) grown at 25C somewhat variable, at first whitish to cream-colored, becoming buff to pale chocolate brown to grayish brown, sometimes with a slightly olivaceous tinge, eventually, after 21 days, dark grayish brown in color, broadly zonate, with alternating dark and pale bands, generally lanose, with an even margin, often sectoring, attaining a diameter of 77 to 82 mm (average 80 mm) after 7 days; sectors arrow-head (Plate 1, C) or fan-shaped, sometimes paler than the remainder of the colony or darker with very little aerial mycelium. Some colonies slightly lobed at the margin, with sparse aerial mycelium, becoming blackish brown and somewhat striate radially, but often producing variously-sized lanose sectors. Reverse pale brown to brown or blackish, frequently with a broad black zone between a central brownish area and a much paler periphery. Colonies on PDA at 20C similar in appearance and color to those grown at 25C but often not darkening to the same degree with age, attaining a diameter of 75-77 mm (average 76 mm) after 7 days. Colonies on PDA at 30C (Plate 1, F) more or less uniformly dark

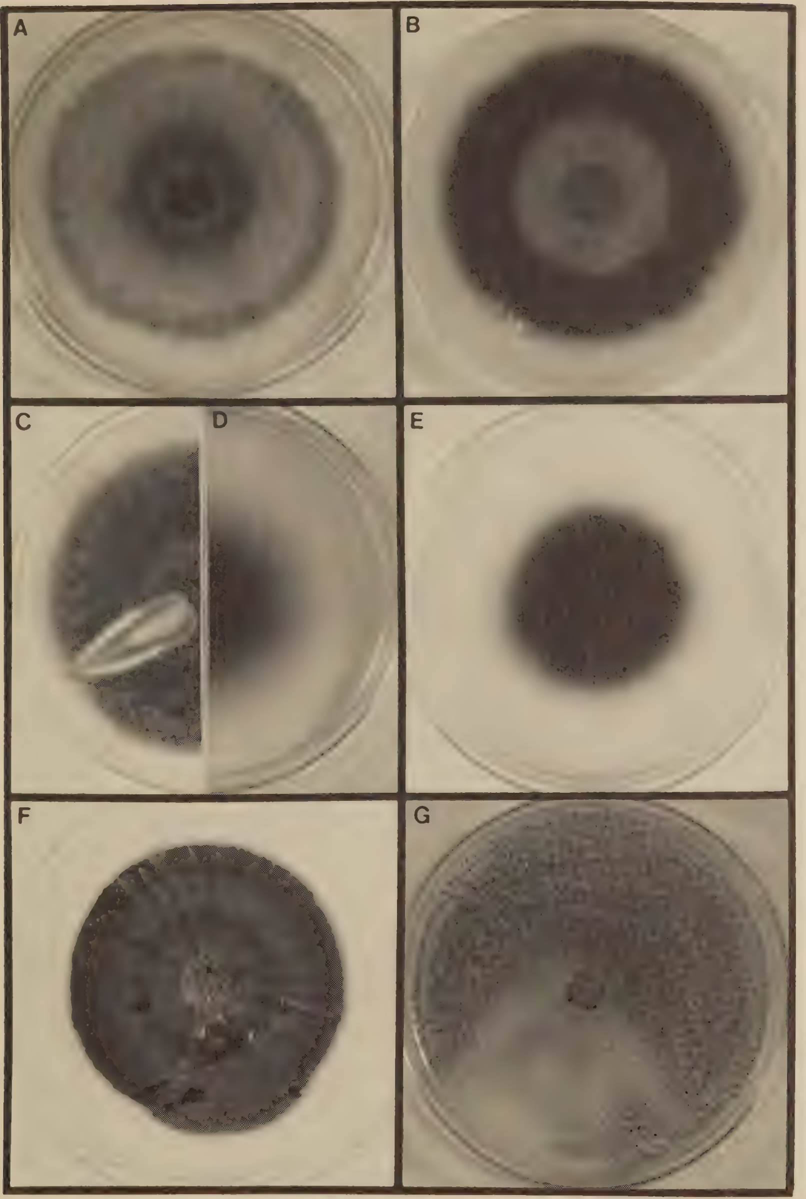


PLATE 1. *Phoma multirostrata.* A, 7-day-old colony on PDA at 25C; B, reverse of same; C, 7-day-old colony on PDA at 25C showing sectoring; D, 7-day-old colony on MEA at 25C; E, 7-day-old colony on MEA at 20C; F, 7-day-old colony on PDA at 30C; G, 14-day-old colony on cellulose agar at 20C.

grayish brown to blackish, felted, zonate, with prominent radial furrows, sometimes with one or more fan-shaped lanose sectors, attaining a diameter of 72 mm after 7 days. Colonies on MEA [Difco] at 25C thin, olivaceous brown, attaining a diameter of 75-80 mm (average 78 mm) after 7 days; at 20C (Plate 1, E) more compact, denser, and thereby somewhat darker with coloration largely derived from immersed mycelium, attaining a diameter of 75-77 mm (average 76 mm) after 7 days; at 35C 15 mm. Colonies on MEA at 30C and 35C, 72 mm and 12 mm in diameter after 7 days, respectively. Colonies on cellulose agar (Plate 1, G) [see Morgan-Jones and White, 1983] thin, with very little aerial mycelium, more or less colorless except for pycnidia, often sectoring, with some sectors bearing scattered pycnidia that are appreciably smaller than those elsewhere, and other sectors remaining sterile. Subisolates prepared from sterile sectors remaining sterile. Mycelium composed of hyphae of two types but with intergradations between them: hyaline, smooth, thin-walled, frequently branched, undulate, widely septate, 1.5-2.5 µm wide; and pale yellowish brown to mid brown, smooth, thicker-walled, sparingly branched, more or less straight, closely septate, 5-7 µm wide. The wider pigmented hyphae sometimes aggregated into closely appressed strands (Plate 2, D); where solitary, individual cells sometimes inflated up to 12 µm, giving a bead-like appearance. On MEA long chains of such entities are common (Plate 3, E). Pycnidia (Figure 1, A; Plate 2, A-C) superficial or immersed, produced readily on PDA, MEA and cellulose agar, in some strains more abundantly on PDA and cellulose agar. In isolates or colony sectors where little aerial mycelium is produced, pycnidia usually highly gregarious to confluent, forming a crust on the agar surface. Pycnidia quite variable in size and shape, sometimes originating symphogenously from hyphal strands (Plate 2, E), single and scattered or, more frequently, gregarious or in dense clusters, globose, subglobose, flask-shaped, or irregular, frequently rostrate, sometimes bearing one or several long, variously shaped necks, with one or, more often, up to nine distinct, well-defined, 11 to 17 µm wide ostioles, brown to blackish when mature, up to 460 µm in diameter, mostly 150-300 µm, invariably covered by a loose network of pigmented, sometimes inflated, hyphae. Necks of pycnidia, where present, up to 240 µm, more common in immersed pycnidia than in those produced superficially on agar surface. Ostioles, where not located at the tips of necks, papillate or non-papillate, bordered by a series of thick-walled cells that are somewhat smaller and darker than are other cells of the outer pycnidial wall layer, either distributed evenly over the exposed portion of a pycnidium or sometimes close together in a pair. Pycnidial wall (Figure 2, D; Plate 3, A-C) four to five cells thick, composed of two types of cells; an outer layer, two cells wide, of thick-walled, pale to mid brown, ellipsoid, or more often, oblong to cylindrical cells and an inner layer of subhyaline to hyaline, thin-walled cells lining the venter. Conidiogenous cells (Figure 1, E) monophialidic, determinate, hyaline, smooth, broadly doliiform, with a thickened periclinal wall, borne as inner cells of the pycnidial wall. Conidia (Figure 1, C; Plate 3, D) enteroblastic, hyaline, smooth, aseptate, straight, oblong with obtuse ends, or slightly ellipsoid, unicellular, mostly eguttulate, or sometimes uniguttulate, 4.5-7 X 2-3 µm. Conidial mass whitish to cream-colored. Chlamydospores (Figure 2, C; Plate 3, E & F) unicellular, ellipsoid, barrel-shaped, broadly oblong or somewhat pyriform, intercalary, in long chains, thick-walled, smooth, pale to mid brown, up to 15 µm in diameter, usually readily produced in 21-day-old colonies on PDA. On MEA chlamydospores generally present but less inflated than those produced on PDA.

Plurivorous; probably widespread in warm climates.

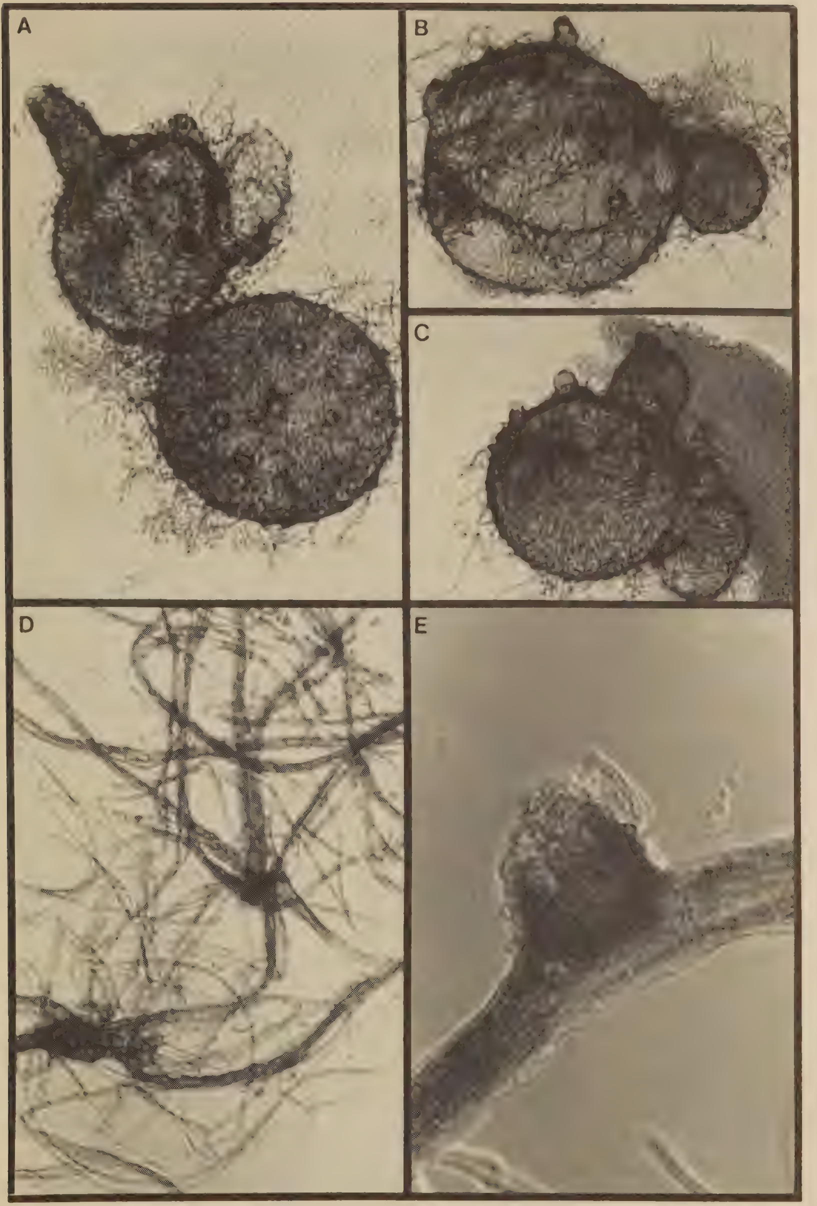


PLATE 2. *Phoma multirostrata*. A–C, rostrate and multiostiolate pycnidia; D, hyphal strands; E, pycnidium originating symphogenously from hyphal strand cells.

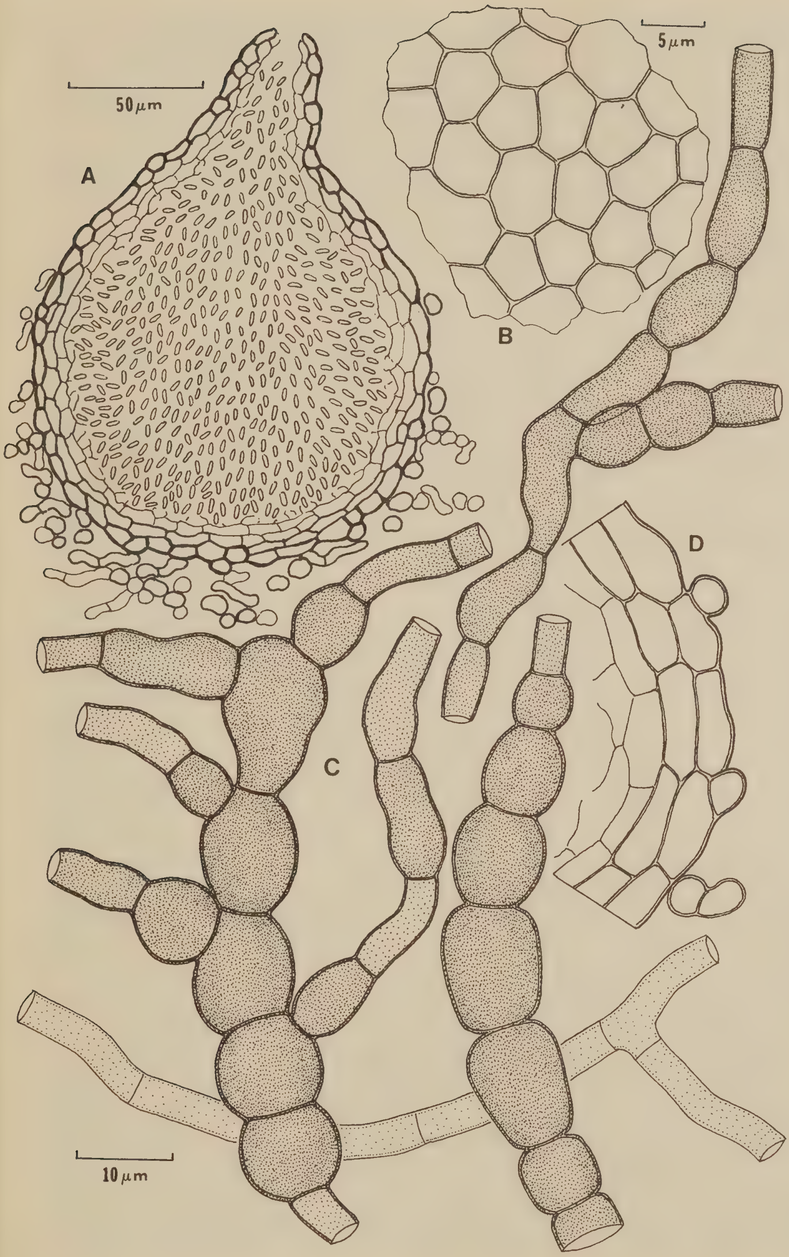
Collections examined: isolated from *Glycine max* (L.) Merr., Jamaica, J.B. Sinclair, PD 86/1185; isolated from *Cucumis sativus* L., The Netherlands, PD86/712; isolated from cysts of *Heterodera glycines* Ichinohe, Summerdale, Baldwin Co., Alabama, U.S.A., September 1980, G. Morgan-Jones, AUA.

DISCUSSION

When Morgan-Jones and Burch (1988a) mentioned that only three species of *Phoma* Sacc., namely *P. eupyrena* Sacc., *P. medicaginis* Malbr. & Roum., and *P. pinodella* (L.K. Jones) Morgan-Jones & Burch (see also White and Morgan-Jones, 1987; Morgan-Jones and Burch 1987), produce unicellular chlamydospores, we were unaware, not having studied *P. multirostrata*, that that species also bears such entities. Although their occurrence has not always been mentioned in previously published descriptions of *P. multirostrata*, it appears that they are usually present in older colonies. Dorenbosch and Höweler (1968) reported finding chlamydospores occasionally in all four isolates examined by them, and Sutton (1980), in his key to *Phoma* species, noted their occasional presence. The term "chlamydospores" has been used in a broad sense in the genus *Phoma* for thick-walled, melanized, swollen entities derived from inflated hyphal cells either terminally or intercalarily. They bear no relationship and only a superficial similarity to chlamydospores *sensu* de Bary (1859). The unicellular chlamydospores of the aforementioned species are all essentially similar in shape, coloration and overall morphology, as well as being catenate. Those of *P. multirostrata*, however, have a tendency to be more doliiform or oblong in shape, or flat-sided, than those of the other species, which are generally ellipsoid to subglobose. The presence *in vitro* of abundant hyphal strands is a feature shared by a number of *Phoma* species; for example, *P. americana* Morgan-Jones & White, *P. eupyrena*, and *P. destructiva* Plowr., as well as *P. multirostrata*. Pycnidia frequently originate from such strands (see Morgan-Jones and White, 1983; Morgan-Jones and Burch, 1988a. 1988b).

As already mentioned, Dorenbosch and Höweler (1968) noted the *in vitro* colony growth characteristics of *P. multirostrata* to resemble those of *P. medicaginis* var. *medicaginis*. They reported varying occurrence of numerous small pycnidia in sectors with little aerial mycelium and other sectors bearing greater mycelial growth and associated, relatively large, pycnidial complexes. Sutton (1980) described cultures of *P. multirostrata* as being thermophilic, growing more rapidly at 30C than at 20C and having a similar colony morphology to *P. medicaginis* var. *pinodella* (L.K. Jones) Boerema [*P. pinodella*]. As noted above, *P. multirostrata* has the added similarity to both *P. medicaginis* and *P. pinodella* in that it produces unicellular chlamydospores. These species are, however, unrelated to *P. multirostrata* and are very dissimilar to it in most other respects. *Phoma americana* Morgan-Jones and White is another species which has broadly similar colony characteristics and resembles *P. multirostrata* in many other features. Dorenbosch and Boerema (1973) had earlier noted temperature/growth relationships in *P. multirostrata* and referred to it as being a thermophilic, soil-borne organism, possibly ubiquitous in warm climates. One isolate studied by Dorenbosch and Boerema originated from an egg mass of a root knot nematode in a greenhouse experiment. In view of this and its apparently common occurrence in cysts, and possibly eggs, of *Heterodera*

FIGURE 2. *Phoma multirostrata*. A, V.S. pycnidium; B, surface view of pycnidial wall cells; C, hyphae and chlamydospores; D, portion of pycnidial wall in section.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A
B
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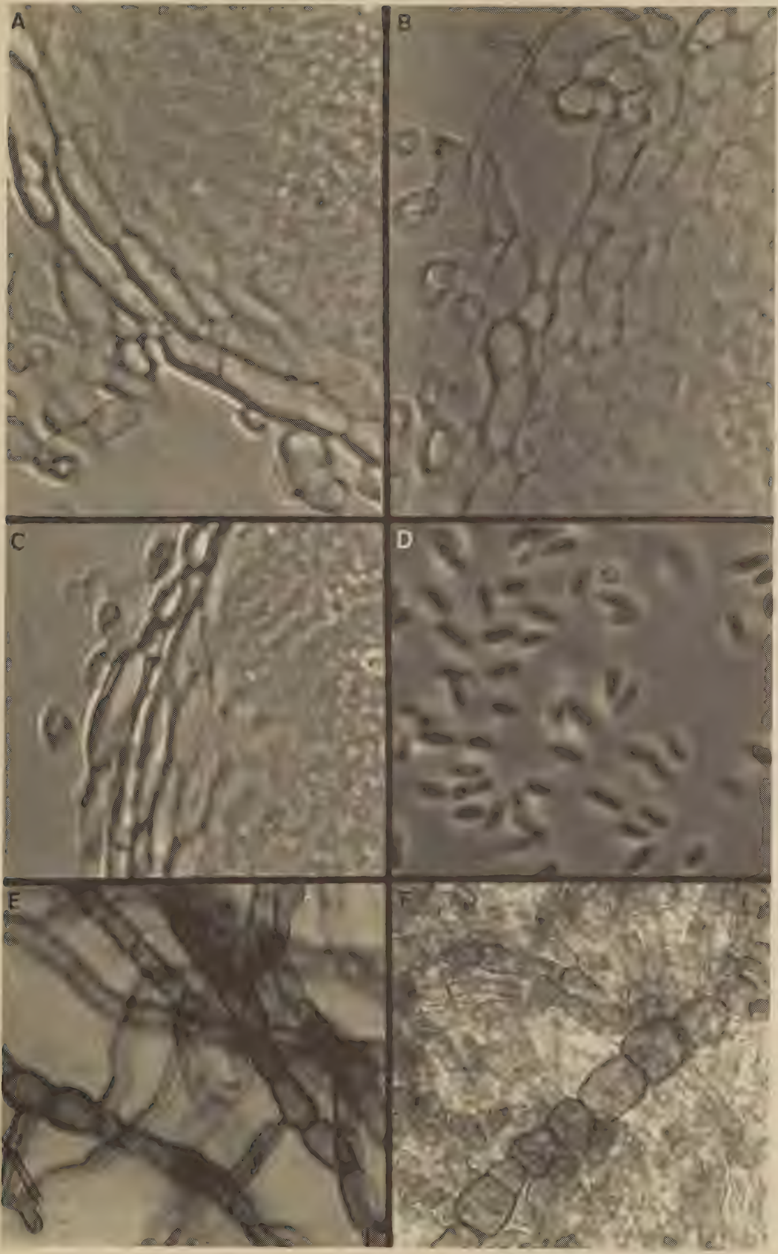
D
10 μm

glycines under some circumstances, a consistent association between it and cyst and root knot nematodes may exist. In temperate regions, *P. multirostrata* has only been found under greenhouse conditions (Dorenbosch and Boerema, 1973), again indicating its need for warm conditions. Since, however, it grows faster at 25C than it does at 30C, it is doubtful that it can be considered to be truly thermophilic, but rather thermotolerant. It does not satisfy the temperature criteria generally understood as being definitive of a thermophilic fungus (see Cooney and Emerson, 1964). In terms of pathogenicity, although known to induce leaf-spots, it needs further study.

As has been discussed previously in this series of papers, cultural characteristics, and colony appearance in particular, tend to be highly variable in the genus *Phoma*. Colony features such as texture and coloration are, to a considerable degree, dependent on temperature, light, and especially the precise nature of the growth medium. Because of this, and the fact that different isolates within species frequently show variability, colony features are not always as reliable as one would wish for purposes of identification. While some species have highly distinctive colonies, others do not, even though they may be easily distinguished by other means. An attempt has been made in preparing colony descriptions to give some account of the range of variation within individual taxa. However, since a limited number of strains are available for study, some isolates may be found that do not fully conform with the cultural characteristics documented, although otherwise typical. To facilitate correct identification, a combination of characteristics is required and recognition of at least one or two key features for each taxon.

Phoma multirostrata belongs to a small group of taxa, including *P. americana*, *P. herbarum*, the type species, and *P. rumicicola* Boerema & Loerakker, that possess a number of characteristics in common. These include the presence of pycnidia with a plurality of well defined ostioles. Such ostioles are usually surrounded by a number of small cells that are appreciably darker than other pycnidial wall cells. Some disagreement exists in recent literature concerning species concepts within the group. Punithalingam (1979) maintained that *Phoma hibernica* Grimes, O'Connor & Cummins is distinct from *P. herbarum* on the basis of conidial width differences, but Boerema (1964) and Morgan-Jones (1988) consider the two to be conspecific. Pycnidia of *P. americana*, *P. herbarum* and *P. rumicicola* may bear up to four ostioles, whereas those of *P. multirostrata*, as indicated above, can have as many as nine. The ostioles in *P. multirostrata* appear to be generally smaller than in the other species. *Phoma americana* and *P. herbarum* are also similar to *P. multirostrata* in having pycnidia that are usually covered by a loose network of hyphae. *Phoma multirostrata* bears the closest similarity to *P. americana*. In addition to the features mentioned above, they also resemble each other in pycnidial wall anatomy, conidium morphology, presence of hyphal strands and in chlamydospore production. The chlamydospores of *P. americana* are, however, different in being mostly septate and sometimes dictyosporous. Although the pycnidia of *P. americana* may sometimes have short necks, these are never as well developed as is the case in *P. multirostrata*. Interestingly, *P. rumicicola* may also produce an occasional pycnidium with a short neck (see figure 3, Boerema *et al*., 1980). Rostrate pycnidia occur commonly in species belonging to *Phoma* sect.

PLATE 3. *Phoma multirostrata*. A-C, portions of pycnidial walls in section; D, conidia (phase contrast); E, chlamydospores on MEA; F, chlamydospores on PDA.


A
B
C
D
E
F

Plenodomus (Preuss) Boerema, van Kesteren & Loerakker. Such taxa as *Phoma leonuri* Letendre, *P. pedicularis* Fuckel and *P. sydowii* Boerema, van Kesteren & Loerakker bear pycnidia with well developed necks (Boerema *et al.*, 1981). Members of this section are, however, very different from *P. multirostrata* in that their pycnidial walls are thicker and scleroplectenchymatous in texture (Boerema and van Kesteren, 1981; Boerema *et al.*, 1981; Boerema and Loerakker, 1985).

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FURTHER NEW SPECIES OF *RELICINA* AND *XANTHOPARMELIA* (LICHENIZED ASCOMYCOTINA) FROM THE SOUTHERN HEMISPHERE

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ABSTRACT : The lichen species, *Relicina ramboldii* Elix & Johnston, *Xanthoparmelia boonahensis* Elix & Johnston, *Xanthoparmelia colensoica* Nash, Elix & Johnston, *Xanthoparmelia gerhardii* Elix & Johnston, *Xanthoparmelia heinari* Elix & Johnston, *Xanthoparmelia lynii* Elix & Johnston, *Xanthoparmelia norpraegnans* Elix & Johnston, *Xanthoparmelia parvoclystoides* Elix & Johnston, *Xanthoparmelia segregata* Elix & Johnston, and *Xanthoparmelia xanthomelanoides* Elix & Johnston are described as new. Apart from the South African *X. colensoica* , the species occur in Australia.

Introduction

As a result of further study of the lichen family Parmeliaceae in the Southern Hemisphere, and particularly in Australasia (Adler & Elix 1987; Elix & Adler 1987; Elix & Johnston 1986, 1987a, 1987b, 1987c, 1988a, 1988b; Elix, Johnston & Armstrong 1986; Nash & Elix 1987; Nash, Elix & Johnston 1987a, 1987b), we are describing 9 new *Xanthoparmelia* and one new *Relicina* species. Throughout the present work chemical constituents were identified by thin layer chromatography (Elix, Johnston & Parker 1987, 1988), high performance liquid chromatography (Lumbsch & Elix 1985) and comparison with authentic samples.

Relicina ramboldii Elix & Johnston, sp. nov. Figure 1

Species cum thallo ut in *Relicina sydneyensis* sed ab hac specie isidiis simplicibus, noncoralloideis et acidum hyposticticum et acidum menegazziaicum continente differt.
Type. Australia. Queensland. On partially shaded basaltic rock walls with a southerly aspect, Jim Crow Mountain, 25 km north-east of Rockhampton, 23°13'S, 150°38'E, 200 - 230 m, *G. Rambold 4487*, 14.ii.1986 ; M-holotype.

Thallus foliose, saxicolous, adnate on rocks, pale green to yellow-green, to 8 cm in diameter. *Lobes* linear-elongate, contiguous centrally to separate at the periphery, (0.5-)1.0-2.0 mm wide, ± imbricate, dichotomously divided, the margins bulbate-ciliate; *cilia* dense and conspicuous, black, simple or rarely furcate-branched, to 1.0 mm long, tapering to markedly inflated basally. *Upper surface* plane to convex, continuous, apices shiny, older lobes extensively cracked, isidiate; *isidia* sparse, simple, globose to short-cylindrical, dark at the tips; medulla white. *Lower surface* brown, rhizines dense, black, elongate, furcate or squarrose-branched. *Apothecia* rare, adnate, to 3 mm in diameter, disc shallowly concave then ± flat or slightly convex, dark brown; the exciple ecoronate,

amphithecium isidiate, retrorsely rhizinate; asci 8-spored, spores simple, colourless, ellipsoid, 7-9 x 3.5-5.5 µm. *Pycnidia* minute, punctiform, immersed; conidia bifusiform, 7-9 x 1 µm.
Chemistry. Cortex K-; medulla K+ yellow-red, C-, P+ orange; containing usnic acid, hypostictic acid (minor), stictic acid (major), constictic acid (trace), menegazziaic acid (minor).

Morphologically this new species closely resembles *Relicina sydneyensis* (Gyelnik) Hale. Both species are characterised by linear-elongate lobes with cylindrical isidia, ecoronate apothecia, a brown lower surface and the presence of stictic acid in the medulla. However these two species are distinguished readily by the morphology of the isidia, the medullary chemistry and their geographic distribution. Thus *R. ramboldii* has sparse, globose, or rarely short-cylindrical, isidia whereas *R. sydneyensis* has dense, coralloid, elongate-cylindrical isidia. Although the chemical constituents observed in these species belong to the same chemosyndrome no overlapping chemistries are observed: *R. ramboldii* always contains hypostictic, stictic and menegazziaic acids as major medullary substances, while *R. sydneyensis* contains stictic, constictic and norstictic acids. *R. ramboldii* is a saxicolous species and has a restricted distribution in central Queensland while *R. sydneyensis* is both corticolous and saxicolous, with a more extensive distribution, being known from temperate coastal areas of southern New South Wales to north Queensland. The latter species is known also from Japan, Taiwan, Indonesia and Papua New Guinea.

Specimen Examined
QUEENSLAND. On vertical and overhanging surface of easterly exposed rock outcrops, Mt. Archer, 7 km north-east of Rockhampton, 23°20'S, 150°35'E, 480 m, *G. Rambold 4456*, 13.ii.1986 (M).

Xanthoparmelia boonahensis Elix & Johnston, sp.nov. Figure 2

Species cum thallo ut in *Xanthoparmelia barbatica* sed ab hac specie thallo diminuto, lobis angustioribus, medulla inferiore pigmentum ochraceum et skyrinum continente differt.
Type. Australia. Queensland. On rocky outcrop, summit of Mt. French, Mt. French National Park, near Boonah, 27°59'S, 152°37'E, > 200 m, *R.W. Rogers 7640;* MEL-holotype.

Thallus small-foliose, adnate on rocks, pale yellow-green, 2-3 cm in diameter. *Lobes* separate, sublinear, not imbricate, 0.8-2.0 mm wide, marginally subrotund. *Upper surface* flat, shiny, emaculate, lacking isidia and soredia; medulla white for the most part, but with a distinct yellow - orange, pigmented zone adjacent to the lower cortex. *Lower surface* pale brown to dark brown, moderately rhizinate, rhizines yellow-brown to black, simple, 0.3 - 0.5 mm long. *Apothecia* adnate, *ca*. 0.5 mm in diameter (immature), margins thick inrolled, disc brown, concave, amphithecium smooth; asci 8-spored, spores ellipsoid, 8-9 x 5-6 µm. *Pycnidia* minute, punctiform, immersed; conidia bifusiform, 5-7 x 1 µm.
Chemistry. Cortex K- ; upper medulla K-, C-, KC+ yellow, P- ; lower medulla K+ violet; containing usnic acid, barbatic acid (major), 4-*O*-demethylbarbatic acid (minor), constipatic acid (trace), protoconstipatic acid (trace), skyrin.

This new species resembles *X. barbatica* (Elix) Egan as both contain medullary barbatic acid, have a pale lower surface and lack soredia and isidia. However *X. barbatica* has larger, tightly adnate thalli, with contiguous lobes and a white medulla, whereas *X. boonahensis* has smaller, more loosely adnate thalli, with separate lobes with a yellow - orange, pigmented lower medulla. This is the first record of skyrin in a barbatic acid-containing *Xanthoparmelia* species. At present this species is known only from the type.

Xanthoparmelia colensoica Nash, Elix & Johnston, sp.nov. Figure 3

Species cum thallo ut in *Xanthoparmelia stenosporonica* sed ab hac specie acidum colensoicum, acidum norcolensoicum, acidum lividicum, acidum physodicum (±) et acidum oxyphysodicum (±) continente differt.
Type. Republic of South Africa. Cape Province. On acidic rocks, Bain's Kloof Pass, 33°35'S, 19°09'E, 600m, *T.H. Nash 23,505,* 20.i.1986; ASU-holotype, PRE-, ANUC-isotypes.

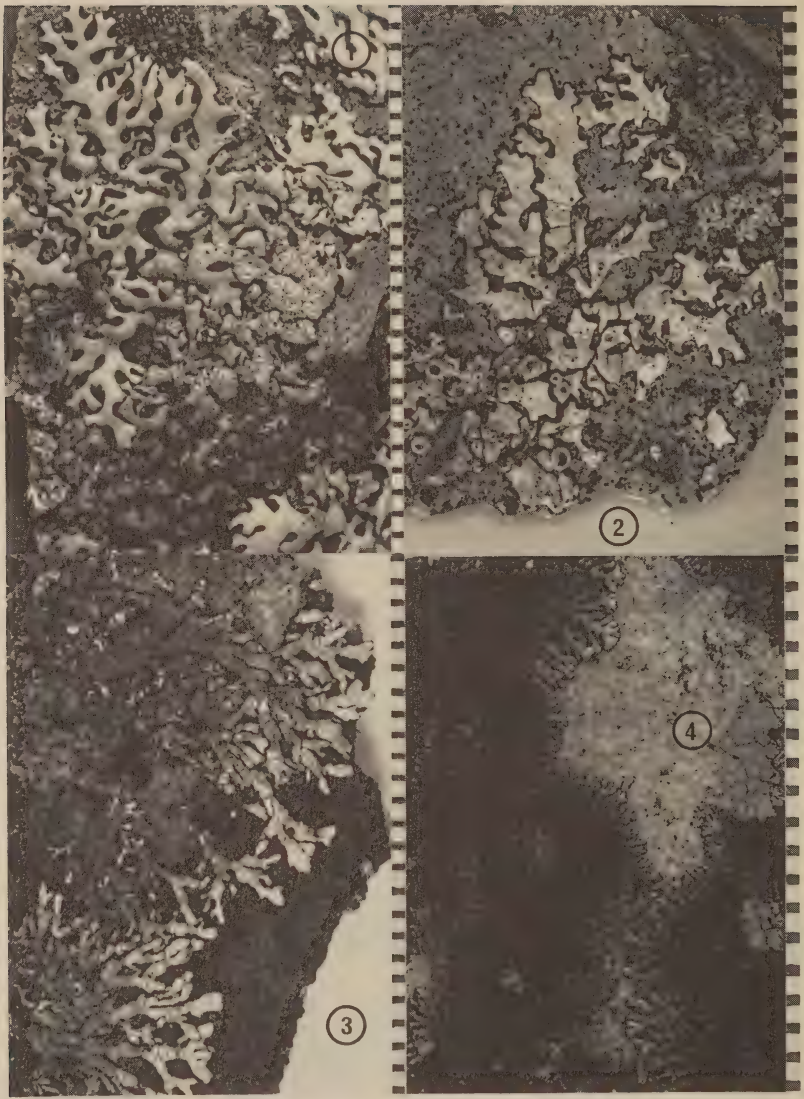
Thallus small-foliose to subcrustose, saxicolous, tightly adnate to adnate, yellow-green but darkening with age and becoming greyish-black, 1-2 cm in diameter. *Lobes* subirregular to sublinear-elongate, (0.2-)0.5-1.0 mm wide, irregularly to subdichotomously branched, imbricate or not so, separate to contiguous, becoming tangentially cracked and areolate in the older, central portion of the thallus. *Upper surface* emaculate, shiny and black-marginate near the apices, dull within, lacking soredia and isidia; medulla white. *Lower surface* plane, black, moderately rhizinate, rhizines black, simple or tufted, 0.1-0.2 mm long. *Apothecia* and *pycnidia* not seen.
Chemistry. Cortex K+ yellow; medulla K-, C-, KC-, P- ; containing usnic acid, colensoic acid (major), norcolensoic acid (minor or trace), stenosporonic acid (trace), lividic acid (trace), physodic acid (trace), oxyphysodic acid (trace), unknown (±).

This new species is characterised by the black lower surface, the small-foliose to subcrustose growth habit and the production of colensoic acid, with traces of stenosporonic acid, norcolensoic acid, lividic acid, physodic acid (±) and oxyphysodic acid, in the medulla. Morphologically and chemically *X. colensoica* closely resembles *X. stenosporonica* Hale. They have similarly subcrustose thalli which lack either soredia or isidia and contain medullary acids belonging to the same chemosyndrome. However the absence of chemical combinants attests to the specific status of these taxa (Elix 1982). *X. shebaiensis* Nash & Elix also is similar chemically, but is distinctly foliose in habit and has a prominently reticulately maculate upper surface. At present *X. colensoica* is known only from the type collection.

Xanthoparmelia gerhardii Elix & Johnston sp.nov. Figure 4

Species cum thallo ut in *Xanthoparmelia louisii* sed ab hac specie acidum consticticum continente differt.
Type. Australia. Western Australia. On sandstone rocks on summit, Mt. Hassell, Stirling Ranges National Park, 848 m, 34°23'S, 118°04'E, *G. Rambold 5384,* 2.iv.1986; M-holotype.

Thallus small-foliose to subcrustose, saxicolous, very tightly adnate, yellow-green but darkening to deep olive-brown or blackish in older lobes, 1-3 cm in diameter. *Lobes* ± contiguous to stellate, linear-elongate, 0.2-0.7(-1.0) mm wide, dichotomously but sparingly branched, sparingly imbricate. *Upper surface* opaque, emaculate, often developing tangential cracks in the older lobes and becoming areolate, lacking soredia and isidia; medulla white. *Lower surface* black, brown towards the apices, sparsely rhizinate, rhizines black, short (*c*. 0.1 mm), rudimentary. *Apothecia* common, sessile, 0.5-1.0 mm in diameter, concave initially then ± flat, disc dark brown to black, exciple smooth, margin involute at first, entire, then ± crenulate; spores (8), 7-9 x 4-6 µm. *Pycnidia* immersed, punctiform, eventually emergent; conidia elongate-bifusiform, 7-8 x 1.0 µm.
Chemistry. Cortex K-; medulla K+ yellow, C-, P+ orange ; containing usnic acid,



Figures 1-4. New species of Parmeliaceae. 1, *Relicina ramboldii* (holotype in M); 2, *Xanthoparmelia boonahensis* (holotype in MEL); 3, *Xanthoparmelia colensoica* (holotype in ASU); 4, *Xanthoparmelia gerhardii* (holotype in M). Scale in mm.

constictic acid (major), stictic acid (faint trace), norstictic acid (faint trace), connorstictic acid (± trace), cryptostictic acid (± trace), atranorin (± trace).

This new species is characterised by the tightly adnate, subcrustose thallus; the linear-elongate, dichotomously divided lobes; the black lower surface and by the production of constictic acid in the medulla. This is the only species of *Xanthoparmelia* known to produce constictic acid as the major secondary metabolite. *X. gerhardii* appears to be related to *X. louisii* Elix & Johnston [which contains barbatic acid and 4-O-demethylbarbatic acid] and *X. xanthomelaena* (Müll. Arg.) Hale [which contains stictic acid as the major secondary metabolite]. Although the chemical constituents observed in *X. xanthomelaena* and *X. gerhardii* belong to the same chemosyndrome, no overlapping chemistries are observed: *X. gerhardii* always contains constictic acid, with faint traces of stictic and norstictic acids; while *X. xanthomelaena* contains stictic acid (major), constictic acid (minor) and norstictic acid (minor). *X. gerhardii* has a restricted distribution in south-western Western Australia while *X. xanthomelaena* is widespread, being found throughout Australia (all States) as well as from South Africa and New Zealand. This new species is named in honour of the collector, Mr. Gerhard Rambold, of the Botanische Staatssammlung München (M).

Specimen Examined
WESTERN AUSTRALIA. On northerly exposed sandstone boulders and cliffs, Mondurup Peak, Stirling Ranges National Park, *c*. 700 m, 34°24'S, 117°49'E, *G. Rambold 5345*, 2.iv.1986 (M).

Xanthoparmelia heinari Elix & Johnston sp.nov. Figure 5

Species cum thallo ut in *Xanthoparmelia filsonii* sed ab hac specie thallo laxe adnato et isidiis globosis differt.
Type. Australia. New South Wales. On semi-exposed sandstone rocks in dry sclerophyll forest on a very rocky ridge, Wauchope Trig, Broken Bago Range, Broken Bago State Forest, 6 km south of Wauchope, 31°31'S, 152°44'E, 350 m, *H. Streimann 38549*, 31.viii.1987; CBG-holotype; Lichenes Australasici Exsiccati, Fasc. 7, isotypes.

Thallus small-foliose to subcrustose, saxicolous, adnate, yellow-green in colour, 5-8 cm in diameter. *Lobes* sublinear, 0.3-0.8 (-1.0) mm wide, irregularly branched, moderately imbricate. *Upper surface* shiny at least apically, emaculate, margins smooth, black, becoming irregularly cracked, isidiate; *isidia* laminal in the thallus centre, simple, globose, then subcylindrical or expanding laterally, rarely branching, ultimately erumpent but not at all sorediate; medulla white. *Lower* surface black, shining, moderately to sparsely rhizinate, rhizines short (0.1-0.2 mm), simple, black. *Apothecia* and *pycnidia* not seen.
Chemistry. Cortex K-; medulla K+ yellow-red, C-, P+ yellow ; containing usnic acid, norstictic acid (major), connorstictic acid (minor).

This new species resembles *Xanthoparmelia filsonii* Elix & Johnston in both morphology and chemistry. However *X. heinari* generally has more loosely adnate thalli with isidia that are globose to short-cylindrical, while the thalli of *X. filsonii* are more tightly adnate, and have isidia are elongated-cylindrical and often densely coralloid-branched. The presence of (sparingly) erumpent isidia, a black lower surface and medullary norstictic acid also bring *X. alexandrensis* Elix & Johnston and *X. pustuliza* (Elix) Elix & Johnston to mind. However the latter species have much larger, distinctly foliose thalli with broader (1-2 mm wide) lobes. In addition *X. alexandrensis* differs in having sublinear-elongate, dichotomously branched lobes, while *X. pustuliza* has extensively pustulate-sorediate isidia. This new species is named in honour of the collector, Mr. Heinar Streimann, of the Australian National Botanic Gardens Herbarium

(CBG). This new species is known only from the type locality.

Xanthoparmelia lynii Elix & Johnston sp.nov. Figure 6

Species cum thallo ut in *Xanthoparmelia incrustata* sed ab hac specie lobis angustioribus et isidiatis differt.
Type. Australia. Northern Territory. On schistose rocks, Brett Creek, Harts Range, *L. A. Craven s.n.*, v.1985; CBG-holotype, MEL-isotype.
Thallus foliose, saxicolous, adnate, yellow-green, 5-10 cm in diameter. *Lobes* irregular to sublinear, 0.4-1.0(-2.0) mm wide, irregularly branched, highly congested, imbricate, revolute, ± canaliculate below. *Upper surface* emaculate, shiny at the apices but otherwise dull, convex, isidiate; *isidia* small (0.1-0.2 mm), simple, globose then distorted-cylindrical, inflated; medulla white. *Lower surface* ivory to pale tan, lobe apices often darkening to dark grey, sparsely to moderately rhizinate, rhizines brown, simple, slender, 0.3-0.5 mm long. *Apothecia* and *pycnidia* not seen.
Chemistry. Cortex K-; medulla K-, C-, KC+ rose, P- ; containing usnic acid, norlobaridone (major), loxodin (minor), ursolic acid (trace).

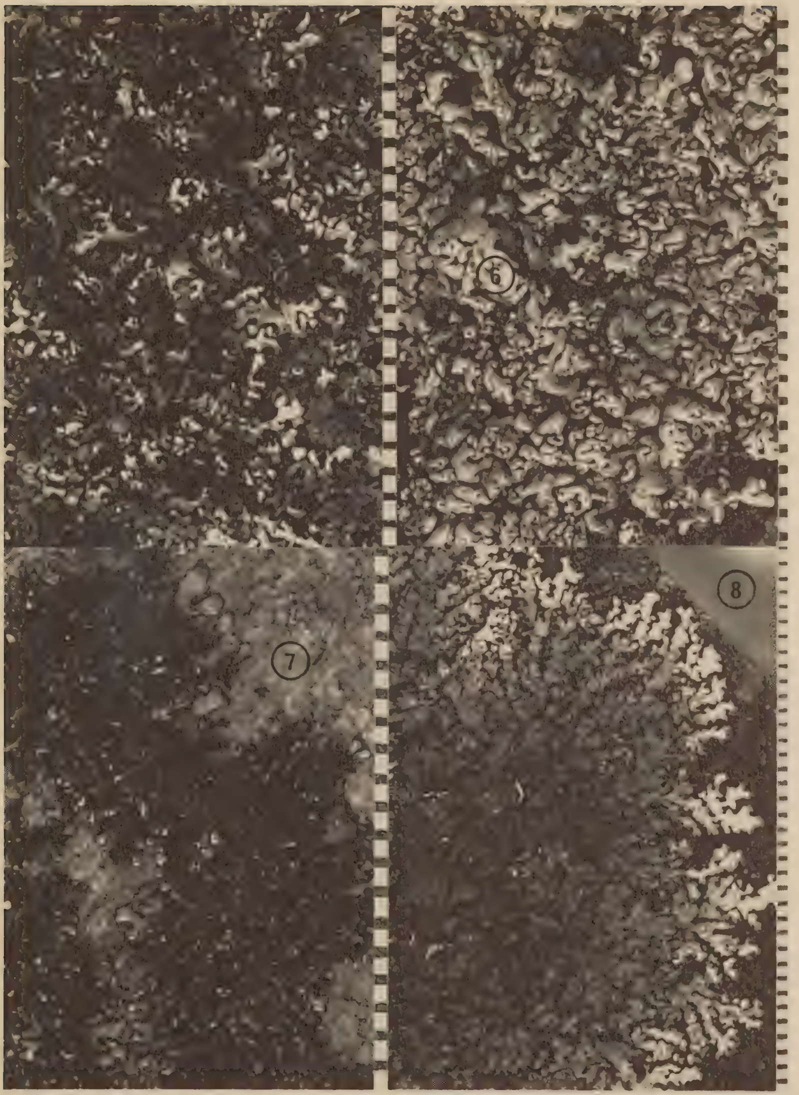
In some respects this new species resembles *Xanthoparmelia incrustata* (Kurok. & Filson) Elix & Johnston as both are adnate to rocks, have a pale lower surface, produce revolute secondary lobes in the thallus centre and contain medullary loxodin and norlobaridone. However *X. lynii* is readily distinguished by the much narrower lobes and the presence of isidia.

The presence of medullary loxodin and norlobaridone; the distorted, warty isidia and pale lower surface also are reminiscent of the common *X. scabrosa* (Taylor) Hale, but this species is moderately to loosely adnate with broader, flat lobes (1.0-3.0 mm wide) and erumpent isidia. In contrast *X. lynii* is more tightly adnate; has convex, narrow (0.5-1.0 mm) lobes and intact isidia. *X. amplexula* (Stirt.) Elix & Johnston, another common species with comparable chemistry, differs in having more or less flat lobes and cylindrical (± coralloid) isidia. This new species is named in honour of the collector, Mr. Lyn Craven, of the Australian National Herbarium (CANB). At present *X. lynii* is known only from the type locality.

Xanthoparmelia norpraegnans Elix & Johnston sp.nov. Figure 7

Species cum thallo ut in *Xanthoparmelia praegnans* sed ab hac specie acidum norsticticum et acidum connorsticticum continente differt.
Type. Australia. Western Australia. On laterite pebbles in open scrubland with *Acacia* and *Eucalyptus* dominant, 4 km east of Bulla Bulling, 31°01'S, 120°52'E, *J. A. Elix 21742 & M. V. Sargent*, 20.viii.1987 ; CBG-holotype.

Thallus small-foliose to subcrustose, saxicolous, tightly adnate, yellow-green but darkening with age, 1-3 cm in diameter. *Lobes* irregular, 0.5-1.0 mm wide, barely imbricate or not so. *Upper surface* shiny at least near the apices, emaculate, margins smooth, becoming tangentially or irregularly cracked, older lobes becoming rugulose and areolate, isidiate; *isidia* laminal in the thallus centre, simple, globose, coarse, becoming short-cylindrical, rarely branched but commonly inflated at the apices and becoming erumpent but not sorediate; medulla white. *Lower surface* pale to light brown, apices darker, shining, moderately to sparsely rhizinate, rhizines short, simple, (*c.* 0.1 mm), concolorous with the lower surface. *Apothecia* and *pycnidia* not seen.
Chemistry. Cortex K-; medulla K+ yellow-red, C-, P+ yellow ; containing usnic acid, norstictic acid (major), connorstictic acid (minor), constipatic acid (±), protoconstipatic acid (±).



Figures 5-8. New species of Parmeliaceae. 5, *Xanthoparmelia heinarii* (holotype in CBG); 6, *Xanthoparmelia lynii* (holotype in CBG); 7, *Xanthoparmelia norpraegnans* (holotype in CBG); 8, *Xanthoparmelia parvoclystoides* (holotype in CBG). Scale in mm.

In overall appearance this new species closely resembles *Xanthoparmelia praegnans* (Elix) Elix & Johnston and, although *X. norpraegnans* is consistently more diminutive, these species are most reliably differentiated chemically. The major constituents of *X. praegnans* are salazinic acid and consalazinic acid while *X. norpraegnans* contains norstictic acid and connorstictic acid. These two species also have different (but overlapping) distributions. Thus *X. norpraegnans* is restricted to inland, south-western Western Australia while *X. praegnans* has a more extensive distribution, being known from throughout Western Australia, central Australia (Northern Territory and South Australia) and western Queensland. *Xanthoparmelia flindersiana* (Elix& P. Armstr.) Elix & Johnston has similar chemistry to *X. norpraegnans* but differs in the larger, distinctly foliose thallus, the broader (1.0-5.0 mm wide) lobes and traces of medullary hypostictic and hyposalazinic acids.

Specimen Examined
WESTERN AUSTRALIA. On exposed sandstone, Kalbarri National Park, "Z" Bend, Murchison River Canyon, *H. T. Lumbsch 5534 d*, 29.viii.1987 (ANUC, CBG).

Xanthoparmelia parvoclystoides Elix & Johnston sp.nov. Figure 8

Species cum thallo ut in *Xanthoparmelia neorimalis* sed ab hac specie lobis latioribus, et acidum norsticticum et acidum connorsticticum continente differt.
Type. Australia. South Australia. On quartz rocks in dry sclerophyll forest, 6.5 km west of Springton along the High Eden road, Mt. Lofty Ranges, 485 m, 34°42'S, 139°02'E, *J. A. Elix 2252,* 20.v.1976; CBG-holotype.

Thallus small-foliose, saxicolous, tightly adnate, yellow-green, darkening with age, 5-7 cm in diameter. *Lobes* sublinear-elongate, 0.4-1.0 (-1.5) mm wide, irregularly branched, imbricate, older lobes sometimes becoming irregularly cracked and areolate, areolae *ca*. 0.5mm wide. *Upper surface* opaque, emaculate, often tangentially or irregularly cracked, older lobes becoming rugulose and eventually areolate, apices often black-marginate, lacking soredia and isidia; medulla white. *Lower surface* pale tan to brown, often darkening to grey-black at the lobe apices, moderately to densely rhizinate, rhizines brown, simple, slender, 0.1-0.2 mm long. *Apothecia* adnate, 1.0-4.0 mm in diameter, disc concave then undulate, dark brown, margin thick, involute at first then becoming thinner and crenulate, amphithecium smooth; spores (8), ellipsoid, 8.5-10.5 x 4-6 μm. *Pycnidia* numerous, black, punctiform, immersed; conidia bifusiform, 5.5-7.0 x 1 μm.
Chemistry. Cortex K-; medulla K+ yellow-red, C-, P+ yellow-orange ; containing usnic acid, norstictic acid (major), connorstictic acid (minor), salazinic acid (± minor) and atranorin (± minor).

This species is characterised by the tightly adnate, small foliose to ± subcrustose thallus, the narrow, sublinear-elongate lobes; the pale lower surface; and the development of tangential cracks in the upper surface of older lobes, which ultimately become areolate. This combination of characters is typical of the so-called *X. dubitata* group (Elix, Johnston & Armstrong 1986) and in particular of *X. neorimalis* (Elix & P. Armstr.) Elix & Johnston. This new species can be most reliably distinguished from *X. neorimalis* by chemical means [*X. neorimalis* contains salazinic acid and consalazinic acid] and could be considered a chemical race of the latter (Elix 1982). However *X. parvoclystoides* has a more restricted, southerly distribution in Australia, although they are sympatric in part. Thus *X. parvoclystoides* is most common in the cooler, wetter areas of South Australia and Western Australia, while *X. neorimalis* is found throughout Australia (all States except Tasmania). Hence we prefer to give this taxon specific status (Elix 1982; Elix, Johnston & Armstrong 1986). Chemically *X. parvoclystoides* is comparable with *X. metaclystoides* (Kurok. & Filson) Elix & Johnston, a species which is adnate to tightly adnate and has a pale lower surface. *X. metaclystoides* is distinguished by the larger thallus (to 12 cm wide) and the broader (1.0-3.5 mm wide), irregular lobes with rotund apices. By comparison *X. parvoclystoides* has a smaller thallus (to 7 cm) and narrower (0.4-1.0 mm), sublinear-elongate lobes.

Specimens Examined
SOUTH AUSTRALIA. On exposed granitic rocks in pasture, The Gap, 6 km west of Palmer, 34°49'S, 139°10'E, 300 m, *J. A. Elix 21756, 21759, 21760 & L. H. Elix*, 30.viii.1987 (ANUC).
WESTERN AUSTRALIA. On rocks in *Eucalyptus* woodland, John Forrest National Park, Darling Ranges, 26 km east of Perth, *J. A. Elix 10497, 10502 & L. H. Elix*, on glass, *J. A. Elix 10504 & L. H. Elix*, 20.x.1982 (ANUC); on exposed granite rocks, Boyagin Rock Reserve, 10 km west of Pingelly, *J. A. Elix 10562A & L. H. Elix*, 21.x.1982 (ANUC); on low granite boulders in sclerophyll forest, 40 km south-east of Armadale, beside Albany Highway, 32°25'S, 116°16'E, *G. Rambold 5274*, 1.iv.1986 (M).

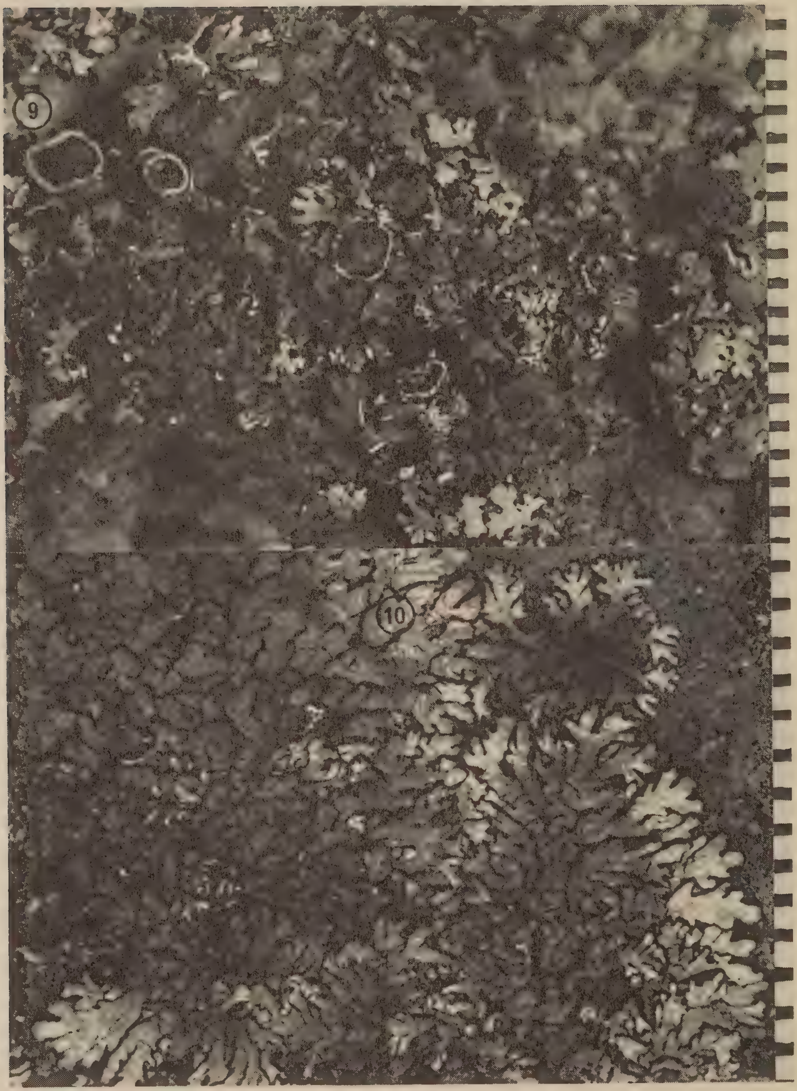
Xanthoparmelia segregata Elix & Johnston sp.nov. Figure 9

Species cum thallo ut in *Xanthoparmelia streimannii* sed ab hac specie lobis irregularibus, isidiis simplicibus et acidum salazinicum, acidum consalazinicum continente differt.
Type. Australia. Victoria. On roadside granite boulders in remnant dry sclerophyll woodland, Elphinstone overpass on Calder Highway, 37°06'S, 144°20'E, *J. Johnston 1502*, 10.xii.1984; CBG-holotype.

Thallus small-foliose, saxicolous, loosely adnate, yellow-green in colour, 4-6 cm in diameter. *Lobes* subirregular to sublinear, (0.3-) 0.5-1.0 mm wide, irregularly branched, moderately imbricate. *Upper surface* shiny at least apically, emaculate, margins smooth, black, isidiate; *isidia* laminal in the thallus centre, simple, globose, then subcylindrical or expanding laterally, rarely branching, not erumpent; medulla white. *Lower surface* brown to pale brown, darker black-brown at the apices, plane, shining, sparsely rhizinate, rhizines short (0.1-0.2 mm), simple, concolorous with the lower surface. *Apothecia* adnate, to 3.0 mm in diameter, disc concave initially then ± flat, pale to dark brown, margin thick, involute at first then becoming thinner and crenate, amphithecium isidiate; spores (8), ellipsoid, 7-9 x 4-5.5 µm. *Pycnidia* not seen.
Chemistry. Cortex K-; medulla K+ yellow-red, C-, P+ yellow ; containing usnic acid, norstictic acid (major), salazinic acid (major), consalazinic acid (minor), connorstictic acid (minor).

This new species resembles *Xanthoparmelia streimannii* (Elix & P. Armstr.) Elix & Johnston in both morphology and chemistry. However *X. segregata* generally has smaller thalli with subirregular lobes and the isidia are globose to short-cylindrical, while in *X. streimannii* the thalli are larger, the lobes sublinear-elongate and the isidia are elongated-cylindrical, often becoming densely coralloid-branched. Furthermore, while *X. streimannii* produces medullary norstictic and connorstictic acids, *X. segregata* produces additional salazinic and consalazinic acids. The presence of simple isidia, a pale lower surface and norstictic-salazinic acid chemistry also brings *X. consociata* (Elix) Elix & Johnston to mind. However the latter species is tightly adnate with a subcrustose growth habit and contains salazinic acid (major) with only traces of norstictic acid. *X. segregata* is rare in hinterland areas of New South Wales and Victoria.

Specimen Examined
NEW SOUTH WALES. On granite batholith along forest border, 3 km east of



Figures 9,10. New species of Parmeliaceae. 9, *Xanthoparmelia segregata* (holotype in CBG); 10, *Xanthoparmelia xanthomelanoides* (holotype in CBG). Scale in mm.

Bungendore, 840 m, *M. E. Hale 59400*, 7.i.1982 (ANUC).

Xanthoparmelia xanthomelanoides Elix & Johnston sp.nov. Figure 10

Species cum thallo ut in *Xanthoparmelia louisii* sed ab hac specie lobis latioribus et acidum sticticum, acidum norsticticum, acidum consticticum et acidum cryptosticticum continente differt.
Type. Australia. South Australia. On quartz rocks in dry sclerophyll forest, 6.5 km west of Springton along the High Eden road, Mt. Lofty Ranges, 485 m, 34°42'S, 139°02'E, *J. A. Elix 2251*, 20.v.1976; CBG-holotype, MEL-isotype.

Thallus small-foliose to subcrustose, saxicolous, very tightly adnate, yellow-green but darkening to deep olive-brown or blackish in older lobes, 2-3 cm in diameter. *Lobes* ± contiguous to stellate, linear-elongate, 0.2-0.8(-1.2) mm wide, subdichotomously branched, sparingly imbricate, becoming cracked. *Upper surface* opaque, emaculate, often developing tangential cracks in the older lobes and ultimately becoming areolate, lacking soredia and isidia; medulla white. *Lower surface* pale tan to brown, darker at the tips, sparsely rhizinate, rhizines concolorous, simple, robust, short (*c*. 0.1 mm), rudimentary. *Apothecia* substipitate, to 1 mm in diameter, disc black, exciple smooth, margin narrow, entire, ± crenulate; spores (8), 8-9 x 6-7 µm. *Pycnidia* immersed, punctiform, ± breaking through the cortex; conidia bifusiform to elongate-bifusiform, 5-9 x 1.0-1.5 µm.
Chemistry. Cortex K-; medulla K+ yellow, C-, P+ orange ; containing usnic acid, stictic acid (major), constictic acid (minor), norstictic acid (minor) and cryptostictic acid (trace).

This new species is characterised by the tightly adnate, subcrustose thallus; the linear-elongate, subdichotomously divided lobes; the pale to brown lower surface and by the production of stictic acid (and satellite compounds) in the medulla. This combination of characters is unique amongst the *Xanthoparmeliae* but this species would appear to be related to *Xanthoparmelia louisii* Elix & Johnston [which contains barbatic acid and 4-*O*-demethylbarbatic acid], but has narrower lobes and a dark brown lower surface. *Xanthoparmelia xanthomelaena* (Müll. Arg.) Hale has identical chemistry and comparable morphology to *X. xanthomelanoides* but differs in having a jet black lower surface. This new species is known from temperate areas of southern South Australia and Western Australia.

Specimen Examined
WESTERN AUSTRALIA. On rocks in low mixed scrub, lookout 1.5 km south-west of Mount Gog, Stirling Ranges, 350 m, *J. A. Elix 10664 & L. H. Elix*, 25.x.1982 (ANUC).

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TAXONOMICAL STUDIES ON USTILAGINALES. III.

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ABSTRACT

Entyloma asterisci-maritimi Vánky, sp. nov. (on Asteriscus maritimus) is described. The following names are validated: Entyloma catananchis Ciferri ex Vánky (on Catananche caerulea), and Urocystis ceratocephali Zambettakis ex Vánky (on Ceratocephalus falcatus). New combinations proposed: Anthracoidea fuirena (Hasija & Wolf) Vánky, based on Cintractia fuirena (on Fuirena simplex); Microbotryum violaceo-verrucosum (Brandenburger & Schwinn) Vánky, based on Ustilago violaceo-verrucosa (on Silene italica); Sporisorium aegypticum (Fischer von Waldheim) Vánky, based on Ustilago aegyptica (on Schismus spp.); Sporisorium foveolati (R. Maire) Vánky, based on Sphacelotheca foveolati (on Andropogon foveolatus); Sporisorium tricholaenae (P. Hennings) Vánky, based on Ustilago tricholaenae (on Tricholaena teneriffae); Thecaphora solani (Barrus ex Thirumalachar & O'Brien) Vánky, based on Angiosorus solani (on Solanum tuberosum subsp. andigenum). The following names are considered synonyms: Entyloma thrinciae R. Maire (type on "Thrincia tuberosa" = misnamed Bellis sylvestris) synonym of Entyloma bellidis Krieger. Sphacelotheca panici-teneriffae Picbauer (type on Panicum teneriffae) synonym of Sporisorium tricholaenae (P. Hennings) Vánky. Tilletia trabutii Jacz. (type on Hordeum murinum), T. hordeina Ranoj. (type on Hordeum maritimum), and T. elymicola Lavrov (paratype on Elymus multicaulis) are considered synonyms of T. controversa Kühn. Ustilago apscheronica Ul'yanishchev (type on "Scleropoa rigida" = misnamed Cutandia memphitica) is Ustilago aschersoniana Fischer von Waldheim. Ustilago schismi Bubák (type on Schismus arabicus) is synonym of Sporisorium aegypticum (Fischer von Waldheim) Vánky. Ustilago stipae-barbatae R. Maire (lectotype on Stipa gigantea) is Ustilago halophila Speg. The genus Angiosorus Thirum. & O'Brien is considered a synonym of Thecaphora Fingerhuth. Neotype is proposed for Ustilago apscheronica Ul'yanishchev (= U. aschersoniana Fischer von Waldheim). Excluded species: Doassansia sintenisii Bresadola (on Cedrula odorata) is the work of insects. Ustilago welwitschiae Bresadola (on Welwitschia mirabilis) is Aspergillus niger van Thiegem var. phoenicis (Corda) Al-Musallam.

In this paper, I present further results of my taxonomical and nomenclatorial investigations on smut fungi.

The study of the original description and of the isotype of Cintractia fuirenae Hasija & Wolf (1969) convinced me that, in spite of the unknown germination type, it is more correct to treat this fungus under the generic name Anthracoidea than to keep it in Cintractia. This fungus presents all characters of an Anthracoidea. The sori are developed in scattered ovaries of a Cyperaceae, forming black, hard, agglutinated, spherical bodies. The "central columella of host tissue" in the middle of sori is the aborted nutlet. Spores single, globose to ellipsoid, 14–19.5 µm long, dark olive-brown; wall c. 1 µm thick, provided with moderately densely situated, prominent, obtusely conic, c. 0.8 µm long warts. Consequently, I propose the following name: *Anthracoidea fuirenae* (Hasija & Wolf) Vánky, comb. nov. Basionym: *Cintractia fuirenae* Hasija & Wolf, Mycologia 61:680, 1969. Type on *Fuirena simplex* Vahl, U.S.A., Dawson County, Nebraska, 17.VIII.1967, R. Kral (HUV 11580!).

Entyloma asterisci-maritimi Vánky, sp. nov. Holotypus in matrice *Asteriscus maritimus* (L.) Less., Algeria, Bejaia (Bougie), Cap Carbon, 5.IV.1912, leg. R. Maire (Herb. Maire 593, MPU!). Paratypi in matrice *Asteriscus maritimus*, Algeria, "Rochers des Grandes Falaises pr. Ziama-Mausouria", 29.XII.1911, leg. R. Maire (Herb. Maire 310, MPU!); Bouzaréa, 31.XII.1914, leg. R. Maire (Herb. Maire 2963, MPU!).

Sori in foliis maculas rotundas brunneas, 1–4 mm diametro formantes. Sporae in textis matricis inclusae compacte dispositae, globosae, subglobosae, ovoideae usque ad mutua pressione parum irregulares, 8–12 x 9–14 µm, pallide flavidobrunneae, pariete 2-stratoso: strato interno aequali, 0,4–0,8 µm, externo parum inaequaliter 0,4–0,8(–1,5) µm crasso, levi. Anamorpha ignota.

Ab *Entyloma asterisci* T. Săvulescu et Rayss (in matrice *Asteriscus pygmeus* Coss.) sporis minoribus (illae *E. asterisci* 11–15 x 12–18 µm) distinctum. *Entyloma mediterraneum* H. et P. Sydow (in matrice *Pallenis spinosa* (L.) Cass., syn. *Asteriscus spinosus* (L.) Schultz Bip.) a fungillo nostro pariete sporarum crassiore (stratum internum parietis sporarum *Entylomatis mediterranei* 0,5 µm, externum autem illius 0,5–3(–4) µm crassum) differt.

Sori (Fig. 1) in leaves forming circular, brownish spots of 1–4 mm in diameter. Spores (Fig. 2) embedded in the host tissue, crowded, globose, subglobose, ovoid to slightly irregular by mutual pressure, 8–12 x 9–14 µm, pale yellowish-brown; wall two-layered, the inner one even, 0.4–0.8 µm, the outer one slightly unevenly thickened, 0.4–0.8(–1.5) µm, smooth. Anamorph not known.

Differs form *Entyloma asterisci* T. Săvulescu & Rayss (on *Asteriscus pygmeus* Coss.) in having smaller spores (11–15 x 12–18 µm in *E. asterisci*), and from *E. mediterraneum* H. & P. Sydow (on *Pallenis spinosa* (L.) Cass., syn. *Asteriscus spinosus* (L.) Schultz Bip.) by thinner spore wall (in *E. mediterraneum* the inner layer measures 0.5 µm, the outer one 0.5–3(–4) µm).

Entyloma catananchis Ciferri ex Vánky, sp. nov. – *Entyloma "catananche* (Maire) Ciferri", 1924:48, nom. nud. – *E. calendulae* (Oud.) De Bary, p.p. (Maire, 1917a:252). – *E. "catananchis"* Ciferri, 1928:56, nom. nud.; *E. "catananches"* Ciferri, 1938:177, nom. nud. – *E. compositarum* Farl. *catananchis* Ciferri, 1963:90 (invalid name, without indication of the rank /ICBN 35.1/ and of the nomenclatural type of the taxon /ICBN 37.1/). – Typus in matrice *Catananche caerulea* L., Algeria, Mt. Djurdjura, in silva Ait-Ouban, 24.V.1915, leg. R. Maire, in Maire, Mycoth. Bor.-Afric. 278 (ut *Entyloma calendulae*). Holotypus in Herbario Ustil. Vánky (HUV 10523), isotypi in Maire, Mycoth. Bor.-Afric. 278. Paratypi in matrice *Catananche caerulea*: Algeria, montium Aurès centralis, in valle Medina, 28.VI.1920, leg. R. Maire (MPU!); montium Djurdjura, mons Tigounatin, 8.VI.1930, leg. R. Maire (MPU!); Marocco, montium Atlas rifain, mons Kraa, 25.VI.1930, leg. R. Maire (MPU!).

Sori in foliis maculas rotundas 1–4 mm in diametro vel propter confusionem earum majores etiam formantes. Sporae globosae, subglobosae usque ad ovoideae vel mutualiter compressae parum irregulares, 8–12 x 9–14,5 µm, subhyalinae usque ad pallide flavidobrunneae, pariete sat aequali 0,8–1,5(–2) µm crasso. Anamorpha ignota.

Sori (Fig. 3) in leaves forming rounded spots of 1–4 mm in diameter, or larger by confluence. Spores (Fig. 4) globose, subglobose to ovoid, or slightly irregular by compression, 8–12 x 9–14.5 µm, subhyaline to pale yellowish-brown; wall rather uniform, 0.8–1.5(–2) µm thick. Anamorph unknown.

Zundel (1953:270) showed that the correct name of the host plant of Entyloma thrinciae R. Maire (1906:CC) is Bellis sylvestris Cyrillo and not Thrincia tuberosa (L.) DC. (= Leontodon tuberosus L.). Therefore, I suspected that E. thrinciae could be identical to E. bellidis Krieger. No essential differences were revealed when the types of these two species were compared. Consequently, Entyloma thrinciae R. Maire (type on Thrincia tuberosa (L.) DC. = misnamed Bellis sylvestris Cyrillo, Algeria, Oran, N. slope of Djebel Mourdjadjo, 9.IV.1906, R. Maire; MPU!) is considered to be a synonym of Entyloma bellidis Krieger (lectotype on Bellis perennis L., Germany, Saxony, Königstein, Bielathal, 16.IV.1895, W. Krieger, in Krieger, Fgi. saxon. 1103 (HUV 653!).

The following types of Tilletia spp. turned out to be indistinguishable from T. controversa Kühn (The small morphological differences between them are within the normal range of variation for this species). Consequently the following are considered to be synonyms of T. controversa:

1) T. trabutii Jaczewskij, 1893:50. Type on Hordeum murinum L., Algeria, El Gurrah(?), 29.IV.1892, comm. L. Trabut (LEP!; comp. also Duran & Fischer 1960:48).

2) T. hordeina Ranojević, 1914:398. Type on Hordeum maritimum Stokes (= H. marinum Hudson), Yugoslavia, distr. Kumanovo, near Stracin, 10.VI.1913, N. Ranojević (LEP!). Without seeing the type, Duran & Fischer (1960:76) and Vánky (1985:137) considered T. hordeina to be a synonym of T. lolii Auerswald ex Winter. In T. lolii the spores has (5–)6–7(–8) meshes per spore diameter and 1.5–3 µm high muri, whereas in T. controversa (including T. hordeina) the spores has fewer meshes, (4–)5–6(–7) per spore diameter, and the muri are lower, 1.5–2.5(–3) µm.

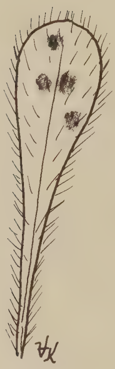
3) Like the lectotype (Vánky 1985:134), the paratype of T. elymicola Lavrov, 1937:1, on Elymus multicaulis Kar. & Kir. (= E. aralensis Regel), USSR, Altai, Kara-Czoku, VIII.1876, A. Regel (LEP!) belongs to T. controversa.

Sporisorium foveolati (R. Maire) Vánky, comb. nov. Basionym: Sphacelotheca foveolati R. Maire, Bull. Soc. Hist. Nat. Afr. Nord. 52:21, 1931. Type on Andropogon foveolatus Delile (= Eremopogon foveolatum (Delile) Stapf, = Dichanthium foveolatum (Delile) Roberty), Algeria, in the mountains of C. Sahara, Tefedest, Oued Araghan, 10.IV.1928, R. Maire (Iter saharicum 1928 no. 1493; Herb. Maire 9455, MPU!).

The type (MPU) and some other additional specimens (in PC), originating from the herbarium of R. Maire, and a specimen, on the same host, from Cape Verde I, Boa Vista, Cruz des Armes, 21.IX.1979, W. Lobin (HUV 9567), have all characters of a Sporisorium. Sori destroy the inflorescence, covered by a delicate membrane which flakes away revealing a dark brown, agglutinated spore-mass surrounding a simple columella. Spores angular-subglobose, often irregular, olivaceous brown, 8–11 x 8.5–13 µm, very finely to evidently verruculose-punctate. Sterile cells usually larger than the spores (14–22 µm in diameter), globose or collapsed, hyaline, thin-walled.

Morphologically this species is close to Sporisorium andropogonis (Opiz) Vánky (type on Dichanthium ischaemum (L.) Roberty), and to Sporisorium puellare (H. Sydow) G. Deml (type on Hyparrhenia hirta (L.) Stapf; see also Vánky, Deml & Oberwinkler, 1988).

Sporisorium tricholaenae (P. Hennings) Vánky, comb. nov. Basionym: Ustilago tricholaenae P. Hennings, in Engler, Bot. Jahrb. 17:3, 1893; Bull. Herb. Boissier 1:114, 1893. Sphacelotheca tricholaenae (P. Henn.) Mundkur, 1944:51. Type on Tricholaena teneriffae (L. fil.) Link, Arabia, Wadi Chafura, in the middle Egyptian desert on the Arabian side, III.1880, G. Schweinfurth /The "2–4 cm longis, usque ad 1 cm crassis" measurements for the sori in both of Hennings' original descriptions were evidently a slip of the pen and should have been, respectively 2–4 mm and 1 mm/. – Syn. Sphacelotheca panici-teneriffae



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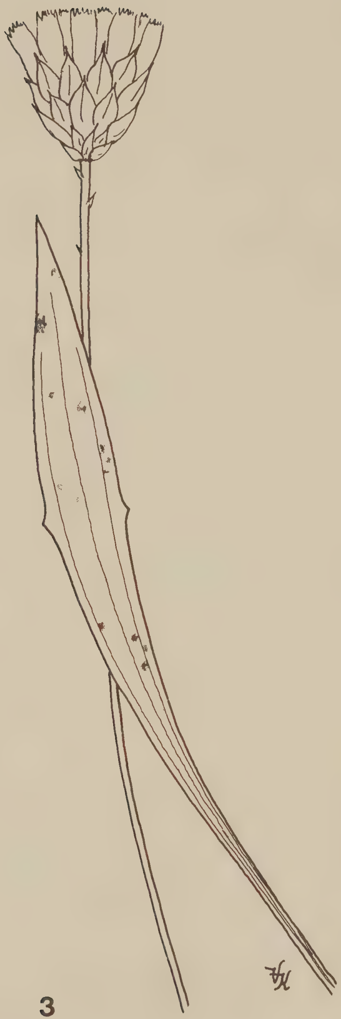

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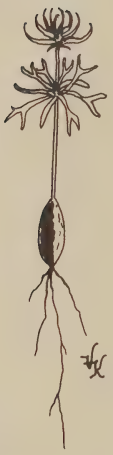

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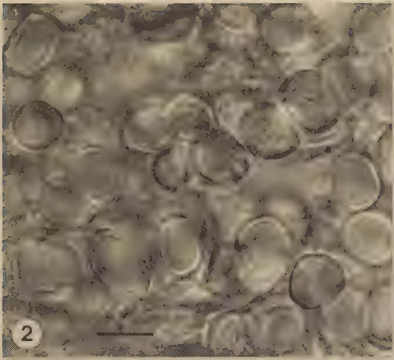

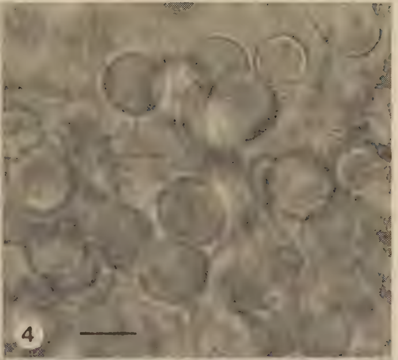

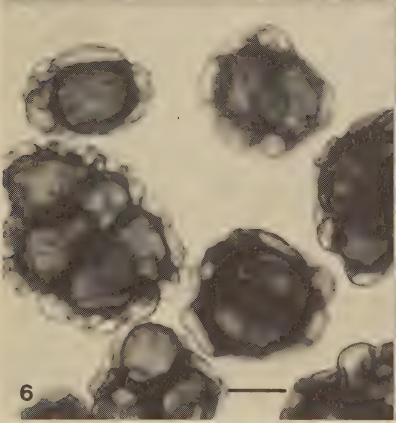

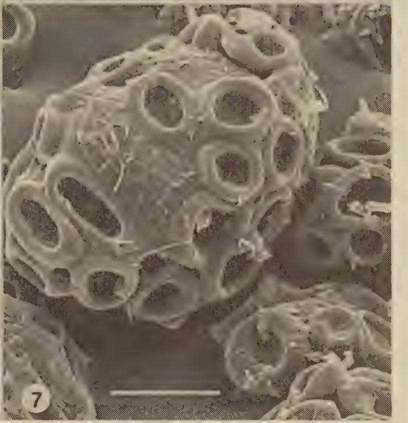

Fig. 1. Sori of Entyloma asterisci-maritimi Vánky on a leaf of Asteriscus maritimus (L.) Less.

Fig. 2. Spores of E. asterisci-maritimi seen in LM (Type).

Fig. 3. Entyloma catananchis Ciferri ex Vánky on a leaf of Catanache caerulea.

Fig. 4. Spores of E. catananchis seen in LM (Type).

Fig. 5. Urocystis ceratocephali Zambettakis ex Vánky on the stem of Ceratocephalus falcatus (L.) Pers.

Figs. 6. & 7. Spore balls of Urocystis ceratocephali Zambettakis ex Vánky (Type) seen in LM and in SEM showing the spores surrounded by an incomplete layer of steile cells. Sterile cells collapsed when dryed. (Bars in all figs. = 10 µm).

("*panici Teneriffae*") Picbauer (1932:3). Type on *Panicum teneriffae* (L. fil.) R. Br. (= *Tricholaena teneriffae*), Israel, Wadi el Kelt near Jericho, alt. c. 100 m, 14.IV.1909, F. Nábělek (BRNM 122731!).

I have not seen the type of *U. tricholenae* but I have seen the type of *Sph. panici-teneriffae* and two other smutted specimens of *Tricholaena teneriffae*, which all correspond with Hennings' description. The fungus has the characters of the genus *Sporisorium*. Sori in the ovaries form ovoid to cylindrical bodies, 1.5–5 mm long and c. 1 mm wide, at first covered by a thick, smooth membrane of both host plant and fungal origin; later the membrane ruptures exposing the dark brown, powdery spore mass and a central columella. Spores when young in large, irregular groups, by mutual pressure polyangular, when mature isolated, globose, ellipsoid or slightly irregular, (6.5–)7–9 x 7–10 µm, dark brown, finely but densely echinulate. Sterile cells between the spores and in the sorus membrane, in groups or in chains, variable in form and size, 5–12 µm long, thin-walled, hyaline. Germination by four-celled promycelia producing laterally and terminally ovoid to elongate sporidia.

A fungal disease, producing severe losses in the South American potato crop, was studied by Barrus & Muller (1943). Its causal agent was described by Barrus (1944) under the name *Thecaphora solani* Barrus. Unfortunately, the name was invalidly published, lacking a Latin diagnosis. Thirumalachar & O'Brien, in O'Brien & Thirumalachar (1972/1974/), based on Barrus' type and description, published this fungus under the name "*Angiosorus solani* Thirum. & O'Brien, sp. nov. – Syn. *Thecaphora solani* Barrus", erecting for it the new monotypic genus *Angiosorus*. In my opinion, the basis for placing this fungus in a separate genus is inadequate (Vánky, 1987:12), and it is better accommodated in the genus *Thecaphora*. There are several possible ways to validate the name *Thecaphora solani*. Taking into consideration Barrus' great merits, I propose the name: *Thecaphora solani* (Barrus ex Thirumalachar & O'Brien) Vánky, comb. nov. Basionym: *Angiosorus solani* Thirumalachar & O'Brien, in O'Brien & Thirumalachar, Sydowia 26:201, 1972(1974). – Syn. *Thecaphora solani* Barrus, Phytopathology 34:714, 1944, nomen nudum. Type on *Solanum andigenum* Juz. & Buk. (= *Solanum tuberosum* subsp. *andigenum*), Venezuela, State Mérida, near Mucuchies, 19.IX.1939, coll. M.F. Barrus & A.S. Muller (CUP 29427).

Consequently, the genus *Angiosorus* Thirumalachar & O'Brien, in O'Brien & Thirumalachar, 1972(1974):201, is considered to be a synonym of *Thecaphora* Fingerhuth, 1836:230, with the type species *T. seminis-convolvuli* (Desm.) S. Ito, syn. *T. hyalina* Fingerhuth.

A smut on the stems of *Ceratocephalus falcatus* (Ranunculaceae), was published by Zambettakis, without a Latin diagnosis. The fungus is described here as follows. *Urocystis ceratocephali* Zambettakis ex Vánky, sp. nov. – *Tuburcinia ceratocephali* Zambettakis, 1971:351 (nomen nudum). – Holotypus in matrice *Ceratocephalus falcatus* (L.) Pers. (Ranunculaceae), Algeria, Sétif, IV.1933, leg. Champagne (Herb. Maire 10839 ut "*Tuburcinia Champagnei* Maire" nom. herb.; MPU!, isotypi in herbario Ustil. Vánky (HUV 13100) et in PC. Paratypus: *Ceratocephalus falcatus*, USSR, Turkmeniya, regio Chardzou, distr. Kerkinsk, secus viam inter Kerki et Kizyl-Ayak, 25.III.1960, leg. O. Nasyrov (HUV 5293!, LE).

Sori tumores fusiformes in caulibus usque ad 1 cm longos formantes, membrana colore cinereo-argentea, longitudinaliter fissa et multitudinem glomerulorum sporarum nigram, granulatam-pulverulentam monstranti cooperti. Glomeruli sporarum subglobosi, irregulariter rotundati usque elongati, 16–35 x 20–45 µm, ex 1–7 sporis centralibus indumentoque cellularum sterilium imperfecto, vel quandoque nonnullis earum tantum, circumdantium efformati. Sporae subglobosae usque ellipsoideae, in lateribus inter se contingentibus saepe compressae, 11–15 x 14–20 µm, atro-rufobrunneae, leves. Cellulae steriles subglobosae, elongatae usque pyriformes et irregulariter compressae, 5–12(–14) µm longae, pallide flavobrunneae, leves.

Sori (Fig. 5) on the stems forming fusiform swellings up to 1 cm long, covered by a grayish-silvery membrane which ruptures longitudinally exposing the black, granular-dusty mass of spore balls. Spore balls (Fig. 6) subglobose, rounded irregular to elongated, 16–35 x 20–45 µm, composed of 1–7 central spores surrounded by an incomplete layer or sometimes only a few sterile cells. Spores subglobose to ellipsoidal, often flattened on contact sides, 11–15 x 14–20 µm, dark reddish-brown, smooth. Sterile cells subglobose, elongate to pyriform and irregularly flattened, 5–12(–14) µm long, light yellowish-brown, smooth.

Known only from two collections on *Ceratocephalus falcatus* (L.) Pers. (Ranunculaceae) from C. Asia and N. Africa. Probably more common but overlooked.

Ustilago aegyptica on different species of *Schismus* (Gramineae) shows the characteristics of the genus *Sporisorium*. The sori destroy the inner part of the spikelets and are covered by a peridium formed of host tissues and fungal elements. The peridium ruptures liberating the black, powdery mass of spores and leaving behind a short, central columella. Spores when young are in loose spore balls, later single, globose to slightly irregular, 9–13.5 x (11–)12–15(–17) µm, echinulate, medium reddish-brown. Sterile cells variable in form and size, rounded to angularly elongated, 4–9 x 5–13 µm, hyaline, thin-walled, smooth, with a few oil droplets. I propose transferring *Ustilago aegyptica* into *Sporisorium* as *Sporisorium aegypticum* (Fischer von Waldheim) Vánky, comb. nov. Basionym: *Ustilago aegyptica* Fischer von Waldheim, Hedwigia 18:100, 1879, on *Schismus calycinus* (L.) Cosson & Durieu (= *S. barbatus* (L.) Thell.), Egypt, G. Ehrenberg (LE!). – Syn. *Ustilago schismi* Bubák (1914:189). Type on *Schismus arabicus* Nees, Mesopotamia, by the Tigris river, between Mossul and Mt. Dschebel Hamrin, near Kalat Schergat (Assur), alt. c. 200–250 m, 15.V.1910, H.F. Handel-Mazzetti (246; BPI 166236!).

Ustilago apscheronica Ul'yanishchev (1950:81), type on "*Scleropoa rigida* (L.) Griseb." (= misidentified *Cutandia memphitica* (Sprengel) K. Richter), USSR, Azerbajdzhan, Baku, Botanical Garden, 5.V.1947, V.I. Ul'yanishchev. The holotype of this species was lost when the herbarium in Baku (BAK) burned down some 20 years ago (Prof. Ul'yanishchev, pers. comm.). However, the study of the paratype (proposed for neotype), preserved in LEP (labelled as "*Ustilago apscheronica* Uljan. sp. n." on "*Scleropoa rigida*", collected near Baku, at the village Shuvelyan, on 21.V.1947, leg. et det. V.I. Ul'yanishchev) revealed that it is *Ustilago aschersoniana* Fischer von Waldheim on stunted *Cutandia memphitica* (= *C. scleropoides* Willk.).

The onion smut originally described as *Ustilago ceparum* by Głowacki, 1891(1892):283, on *Allium cepa* L. from Austria, Steyermark, near Pettau, collected 1881 or 1882 by J. Głowacki is an enigma. The location of the type is unknown. Based on the original description, the fungus destroys the bulbs. Its spores are globose, rarely ovoid to oblong, 6–9 µm in diameter, light reddish-brown, apparently smooth but densely and minutely verruculose. Spores reportedly germinate by a promycelium with lateral outgrowths (Głowacki /1891/1892:283).

Another "smut", *Ustilago allii*, on scale leaves of stored onion bulbs, from Australia was described by McAlpine (1895:220). According to McAlpine, the fungus forms minute, dark coloured pustules in parallel lines along the veines, at first covered by the epidermis than pulverulent, black, in streaks or blending into masses. Spores spherical, echinulate, dark-brown, 4–4.5 µm in diameter, imbedded in a gelatinous mass. The gelatinous mass is transversed here and there by 3 µm broad septate hyphae. These characters are very unusual for a *Ustilago* and I strongly doubt that it is a smut.

I have seen a few bulbs of onion, preserved in different herbaria under these two names, which proved to be partially destroyed by *Aspergillus niger* van Tiegh. s. lat. (USSR, Tula, 1925, L. Gitmann, LEP; Lituania, Vilnius, Dvarčionys, IX.1972, M. Ignatavičiute, 1975:105, HUV 12390). One specimen, however, is extremely interesting, namely *U. ceparum* on *Allium cepa* from Alma-Ata, 20.VII.1950, I.N. Golovenko (AA!), illustrated by Schwarzman (1960:141). Sori develop in the bulb and leaves. A reddish-brown, powdery spore mass is produced in the sori. Spores globose or subglobose, 7–10 x 7–11 µm, moderately densely and evidently verruculose so that the spore profile appears finely and scantily serratulate. Despite some discrepancies between the description of the spores of the type of *U. ceparum* (which may be a result of inadequate optics in the microscopes of the times) and the characters of the fungus from Alma-Ata, the two probable represent the same species. This is evidence for the existence of a second *Ustilago*-like "smut" on onion, in addition to *Aspergillus niger* and the better known *Urocystis magica* Passerini (= *Ur. cepulae* Frost, = *Ur. allii* Schellenberg).

The study of the two syntypes of *U. stipae-barbatae*, on *Stipa* spp., showed that they are indistinguishable from *U. halophila* Speg. Consequently, the correct name for this fungus should be *Ustilago halophila* Spegazzini (1902:58; Type on *Distichlis scoparia* (Kunth) Arech., Argentina, Santa Fé, near Rufino, XII.1900, C. Spegazzini; LPS 3198!). – Syn. *U. stipae-barbatae* R. Maire, 1917:139; *Cintractia stipae-barbatae* (R. Maire) R. Maire (in Maire & Werner, 1937:44). Lectotype on *Stipa barbata* Desf., Morocco, Taourirt, 4.VI.1916, L. Ducellier (Herb. Maire 4226, MPU!). Syntype on *Stipa gigantea* Link, Algeria, Miliana, near the top of Zaccar Rharbi, 12.VII.1917, R. Maire (Herb. Maire 4810, MPU!). Sori surround the distal internodes and the rachis of the aborted inflorescence, at first enclosed by a thin grayish membrane which ruptures liberating the dark brown, powdery mass of spores. Spores olivaceous-brown, subglobose to slightly irregular, 5–6.5 x 5.5–8 µm, often slightly compressed (4–5.5 µm thick), lacking evident polar caps. I found an additional specimen of *U. halophila* on *Stipa pennata* L. from Turkmenia, VI.1924, E. Czerniakowska, in LEP, labelled with "*Tranzscheliella kazakhstanica* Lavrov", apparently a herbarium name.

U. williamsii (syn. *Tranzscheliella otophora* Lavrov) differs from *U. halophila* by having larger spores with evident bipolar appendages ("polar caps").

Ustilago violaceo-verrucosa Brandenburger & Schwinn, in the anthers of *Silene* spp. differs from the closely related *Ustilago violacea* in having a verruculose rather than a reticulate spore surface. For the anthericolous smuts of Caryophyllaceae Deml & Oberwinkler (1982) reinstated the genus *Microbotryum*. I propose transferring *U. violaceo-verrucosa* into the genus *Microbotryum* as *M. violaceo-verrucosum* (Brandenburger & Schwinn) Vánky, comb. nov. Basionym: *Ustilago violaceo-verrucosa* Brandenburger & Schwinn, in Nova Hedwigia 22:883, 1971(1974). Type on *Silene italica* (L.) Pers., Italy, Liguria, prov. Savona, Alasso, near Vegliasco, 350 m, 18.V.1969, W. & W. Brandenburger (HUV 10482!). – Syn. *Ustilago gausseni* Durrieu, 1972:433 (invalidly published, no type indicated; ICBN Art. 37.1).

EXCLUDED SPECIES

I could not find spore balls of *Doassansia* or spores of any kind in the type specimen of *Doassansia sintenisii* Bresadola, on *Cedrula odorata* L. (Liliaceae), from Puerto Rico, 25.III.1887 (LEP!). Lesions on the leaves were in all probability the work of insects (comp. also Zundel, 1953:232).

Zundel (1953:220), apparently without seeing material of *Ustilago welwitschiae* Bresadola (in Saccardo, 1893:68) wrote: "It is doubtful if this species is one of the Ustilaginales. It seems to be near the genus *Graphiola*". Al-Musallam (1980:57) considered it to be *Aspergillus niger* van Tieghen var. *phoenicis* (Corda) Al-Musallam. This statement was recently confirmed by Dr.

R.A. Samson (Baarn, The Netherlands; in litt.) and by Professor F. Oberwinkler (Tübingen, W. Germany; pers. comm.) both of whom checked the isotype (in Flora Lusitanica Exsiccata 1213. "Ustilago Welwitschiae Bres. n. sp., Nas pinhas da Welwitschia mirabilis Hook. fil., Coimbra: Museu Botanico. Leg. A. Möller. Julho de 1893"; HUV 5197) and an additional specimen (in Reliquae Petrakianae 310. "Ustilago welwitschiae Bres." on Welwitschia mirabilis, South Angola, 1952, leg. H. Hess; HUV 8871).

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MYCOTAXON

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SOME NEW OR UNUSUAL CORTICIOID FUNGI FROM THE GULF COAST REGION [1]

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SUMMARY

Three species of corticioid fungi from the Gulf Coast region, *Crustoderma nakasoneae, Hyphoderma nudicephalum*, and *Hyphodontia orasinusensis* are described as new. *Hyphodontia microspora* is reported from North America for the first time. Additional records of *Vararia sphaericospora,* previously known in North America only from the type collection in Georgia, and *Epithele capitata,* previously known only from the type and one other collection in Florida, are reported. *Skvortzovia furfurella* is reported as common and widespread in the Gulf Coast region. The new genus *Dextrinocystis* and the new combination *Dextrinocystis capitata* are proposed. All are white rot fungi except *C. nakasoneae,* which is associated with a brown rot.

During the past several years we have investigated the wood-rotting fungi of the Gulf Coast Region from Florida to East Texas. The area studied is probably one of the most productive for wood-rotting fungi in North America. The relatively high rainfall (50-60 inches per year) with 15-20 inches in the late summer and fall fruiting season from August through November and late frosts (generally the first frost occurs between mid November and late December) result in favorable conditions for development and fruiting of wood-rotting fungi over a long period. A large percentage of the area is forested, with many angiospermous genera and species. In addition, southern pines, bald cypress and junipers are well represented throughout the area,providing excellent coniferous substrates. These factors acting together produce a rich flora of wood-rotting basidiomycetes. This field work has yielded a number of undescribed or otherwise noteworthy species, seven of which are the subject of this paper, and three of these are described as new.

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[1] University of Arizona Agricultural Experiment Station Journal Article No. 5055.

Microscopic characters were determined from free-hand sections or squash mounts in 4 percent KOH and in Melzer's reagent. Drawings were made with the aid of a camera lucida on a Leitz Labolux microscope. Capitalized color names are from Ridgway (1912).

CRUSTODERMA NAKASONEAE Gilbn. & M. Blackwell, sp. nov.

Fructificatio annua, resupinata, pallido-bubalina vel avellanea; systema hypharum monomiticum; hyphae fibulatae, 2.5-4 µm diam; cystidia cylindrica vel clavata, tenui- vel crassitunicata, 60-140 x 7.5-17 µm; basidiosporae cylindricae, hyalinae, laeves, non-amyloideae, 7-8 x 2.5-3 µm; putrido brunnea. Holotypus: R.L. Gilbertson No. 15968, on *Pinus taeda,* Idlewild Exp. Farm, LSU, West Feliciana Parish, Louisiana, Aug. 23, 1986; in herb. Nat. Fungus Collections, Beltsville, MD (BPI).

Etymology: Named for Karen K. Nakasone, (Mycologist, Center for Forest Mycology Research, Forest Products Laboratory, USFS, Madison, Wisconsin), who has contributed greatly to our knowledge of the genus *Crustoderma*.

Basidiocarps annual, resupinate, effused up to 7 cm, membranous; hymenial surface smooth, Light Buff to Avellaneous, conspicuously cystidiate under a 30x lens, some of the cystidia appearing bulbous at the apex; margin concolorous to whitish, thinning out, fimbriate in some areas; subiculum very thin, soft.

Hyphal system monomitic; hyphae thin- to thick-walled, with clamps at all septa, with frequent branching, often branching from clamps, 2.5-4 µm in diam.

Cystidia abundant, cylindric to clavate, some with an expanded base, thin- to thick-walled, with the wall thinning at the apex, not incrusted, 60-140 x 7.5-17 µm, brittle and breaking readily under the cover glass, with a basal clamp.

Basidia narrowly clavate, 4-sterigmate, 91-30 x 4.5-5.5 µm, with a basal clamp.

Basidiospores cylindric, hyaline, smooth, negative in Melzer's reagent, 7-8 x 2.5-3 µm.

Type of rot - Associated with a brown cubical rot of dead pine.

Specimens examined: LOUISIANA: RLG 15968, on fallen *Pinus taeda* L., Idlewild Exp. Farm, LSU, East Feliciana Parish, (Holotype): MB 593, on pine fence post, Thompson's Creek, West Feliciana Parish.

Remarks: *Crustoderma nakasoneae* is similar to *C. dryinum* (Berk. & Curt.) Parm. in spore morphology, but the spores of the latter species are larger (8-12 x 3-4 µm). Also, the cystidia of *C. dryinum* are more cylindric and it has golden yellow basidiocarps. None of the other species of *Crustoderma* reviewed by Nakasone (1984) are comparable to *C. nakasoneae*.

DEXTRINOCYSTIS Gilbn. & M. Blackwell, gen. nov.

Fructificatio resupinata, mollis, laeves, pallido-bubalina; systema hypharum monomiticum; hyphae fibulatae; cystidia cylindrica,crassitunicatae, valde dextrinoideae, saepe radicatus, apices incrustatus;

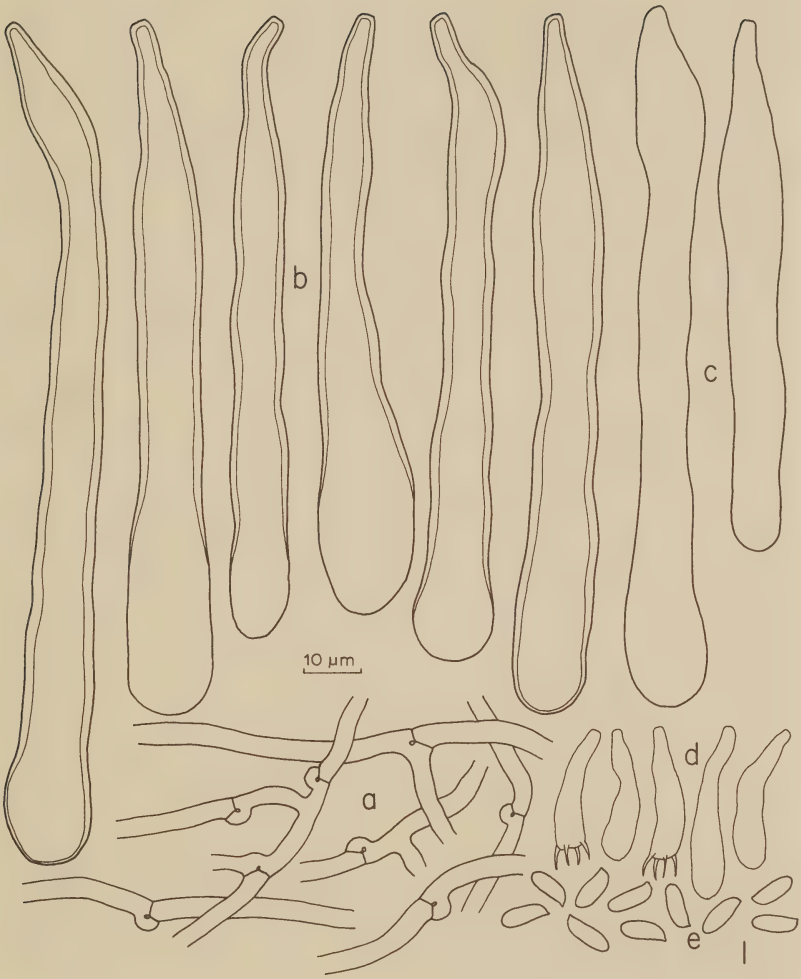

Fig. 1. *Crustoderma nakasoneae* (RLG 15968). a, subicular hyphae; b, thick-walled cystidia; c, thin-walled cystidia; d, basidia; e, basidiospores.

basidia clavata vel utriforme, 4-sterigmatibus; basidiosporae cylindricae, hyalinae, laeves, non-amyloideae.
Type species: *Epithele capitata* D.P. Rogers and Boquiren.
Generitype specimen: R. Singer No. F832, on dead leaves of *Phoenix canariensis,* Suptropical Exp. Station, Homestead, Dade County, Florida, U.S.A., Sept. 23, 1942 (ILL).
Etymology - named for the strongly dextrinoid cystidia.

DEXTRINOCYSTIS CAPITATA (D.P. Rogers and Boquiren) Gilbn. & M. Blackwell, comb. nov. Basionym: *Epithele capitata* D.P. Rogers & Boquiren, in Boquiren, Mycologia 63:942. 1971. *Tubulicium capitatum* (D.P. Rogers & Boquiren) Burds. & Nakasone, Mycotaxon 17:265. 1983.
Basidiocarps annual, resupinate, effused up to 7 cm, soft and easily separated from substratum; hymenial surface Pale Ochraceous Buff to Light Buff, smooth, appearing wooly-tomentose and cystidiate under a 30x lens; subiculum pale buff, less than 1 cm thick, soft.
Hyphal system monomitic; generative hyphae thin-walled, with clamps, 1.5-4 µm in diam; some with frequent cystidiate branches 0.5-1.5 µm in diam, 6-22 µm long and with an apical umbrella-like cluster of pendent crystals, also some hyphae with inconspicuous swollen segments up to 7 µm in diam.
Cystidia abundant, cylindric, tapering slightly to the apex, often with a branching base and appearing rooted, thick-walled with a narrow lumen, capitately incrusted with an umbrella-like cluster of pendent crystals, strongly dextrinoid in Melzer's reagent except for a short apical portion which appears hyaline, wall thick to the apex, 80-120 x 6-9 µm, 2-4 µm in diam at the apex, branching base and occasionally segments of attached hyphae also thick-walled and strongly dextrinoid, in KOH and phloxine some cystidia seen to have fine hyphae appressed to surface, cystidia not dissolving in 10 percent KOH.
Basidia clavate to utriform, 4-sterigmate, 22-30 x 6-8 µm, with a basal clamp.
Basidiospores cylindric to slightly curved, hyaline, smooth, negative in Melzer's reagent, 11-14 x 3-4 µm.
Type of rot: The Louisiana specimen on bamboo culms is associated with a uniform white rot.
Specimens examined: FLORIDA. R. Singer, No. F832, on dead leaves of standing *Phoenix canariensis,* Subtropical Exp. Sta., Homestead, Dade County, FL. Sept. 23, 1942 (Holotype-ILL). LOUISIANA: MB 2386, on dead culms of *Bambusa* sp., LSU Burden Farm, Baton Rouge, E. Baton Rouge Parish, LA.
Remarks: The strong dextrinoid reaction of the cystidia in Melzer's reagent is a striking character of *D. capitata,* but is not mentioned in the original description or by Burdsall and Nakasone (1983). This is apparently only the third report of this distinctive species, previously known only from the type cited above and one other collection on *Sabal palmetto* in Florida (Burdsall and Nakasone, 1983).

HYPHODERMA NUDICEPHALUM Gilbn. & M. Blackwell, sp. nov.
Fructificatio annua, resupinata, cremea vel pallido-bubalina, farinacea vel odontoidea; systema hypharum monomiticum; hyphae fibulatae, 2.5.5 µm in diam., cystidia dimorpha, aliqua cylindrica, incrustata; cetera capitata, nudicephala; basidia clavata, 4-sterigmatibus, 20 - 25 x 5-6 µm; basidiosporae cylindricae, laeves, nonamyloideae, 7-9 x 3.5-4 µm.
Holotypus: M. Blackwell No. 944, on *Liquidambar styraciflua* L.,

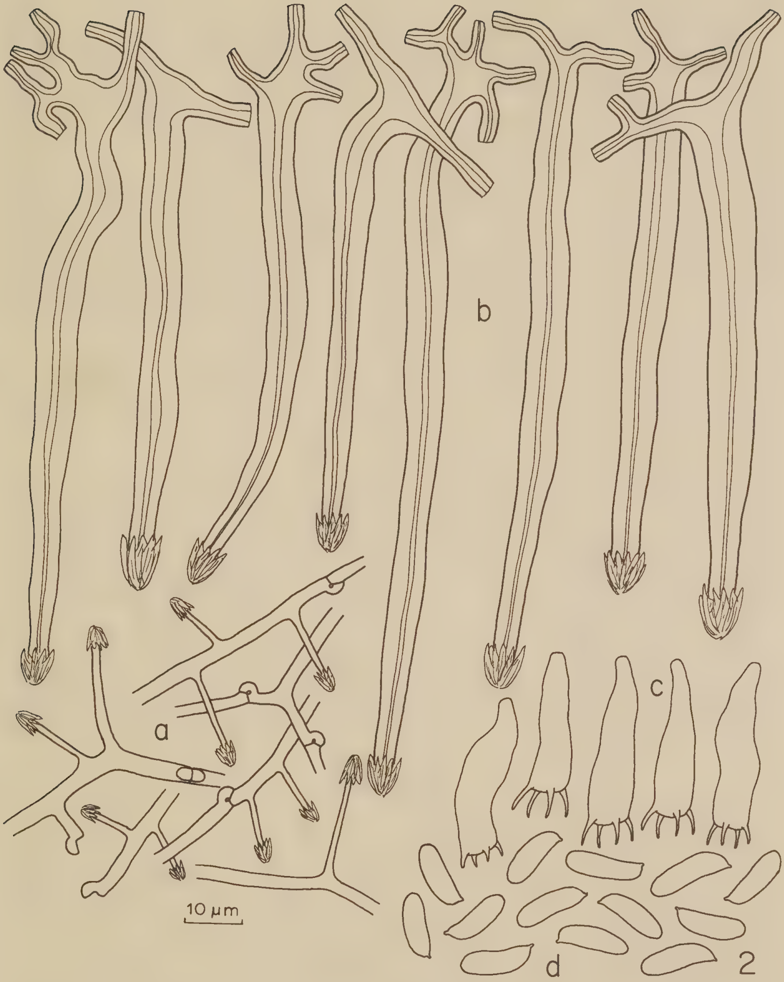

Fig. 2. *Dextrinocystis capitata* (MB 2386). a, subicular hyphae with apically incrusted branches; b, cystidia; c, basidia; d, basidiospores.

Fontainebleau State Park, St. Tammany Parish, LA, Oct. 2, 1982, in herb. National Fungus Collections, Beltsville, MD.

Etymology: with a bald head; named for the capitate cystidia with nonincrusted apices.

Basidiocarps annual, resupinate, becoming effused up to 20 cm; hymenial surface Cream Color to Light Buff or Cream Buff, farinaceous to odontioid, the aculei short, crowded, cystidiate at the apices; margin abrupt to thinning out and farinaceous to arachnoid; subiculum soft, cottony, thin.

Hyphal system monomitic; subicular hyphae with abundant and conspicuous clamps, thin- to thick-walled, with frequent branching, 2.5-5 µm in diam.

Cystidia conspicuous, frequent, of two types; some thick-walled, with clamps, cylindric, tapering toward the apex, often completely incrusted with coarse crystals, up to 230 µm long and 10 µm in diam., with a basal clamp; others clavate with a tapering base and a swollen, bulbous apex, wall thickened at the base and thinning at the apex, apical bulb not incrusted, up to 14 µm in diam, rest of cystidium below the apical bulb loosely to heavily incrusted with coarse crystals, entire cystidium up to 130 µm long, with a basal clamp.

Basidia clavate, 4-sterigmate, 20-25 x 5-5.5 µm, with a basal clamp, in much-branched candelabra.

Basidiospores cylindric, hyaline, smooth, negative in Melzer's reagent, 7-9 x 3.5-4 µm.

Type of rot - White rot of dead hardwoods.

Specimens examined - LOUISIANA; MB 944 (Holotype) and MB 1449, on *Liquidambar styraciflua* L., Fontainebleau State Park, St. Tammany Parish; MB 1285, on *Nyssa sylvatica* L., LSU Burden Farm, Baton Rouge, East Baton Rouge Parish; MB 1476, on *L. styraciflua,* Pearl River, St. Tammany Parish; RLG 14730A, on *Quercus phellos* L., Florida Blvd., Baton Rouge. TEXAS: RLG 13263, on *Quercus nigra* L., Lumberton, Hardin County.

Remarks - *Hyphoderma nudicephalum* is a member of the *H. setigera* complex, but is distinguished by the conspicuous capitate cystidia with nonincrusted apices. There are probably other undescribed species in this complex as pointed out by Eriksson and Ryvarden (1975). Typical *H. setigera* specimens lacking the capitate cystidia are also common in the Gulf Coast Region.

HYPHODONTIA MICROSPORA John Erikss. & Hjortst., In John Erikss. & Ryv., Cort. North Eur. 4:651. 1976.

Basidiocarps annual, resupinate, effused up to 8 cm, soft, easily separated from substratum; hymenial surface Light Buff to Cartridge Buff, farinaceous to distinctly odontoid with short, conical teeth, apices of teeth finely fimbriate under a 30x lens; margin thinning out but fertile almost to the edge.

Hyphal system monomitic; subicular hyphae thin- to firm-walled, with clamps, with frequent branching, 2-3.5 µm in diam.

Cystidia clustered at apices of teeth and occasional in hymenium, tubular, cylindric with a narrowed base, thin- to firm-walled with wall thinning to apex, not incrusted, up to 150 µm long and 6-7.5 µm in diam. at the apex, projecting up to 80 µm, with a basal clamp, some cystidia in apical clusters with simple septa or clamps.

Basidia clavate, 4-sterigmate, 12-15 x 4-5 µm, with a basal clamp.

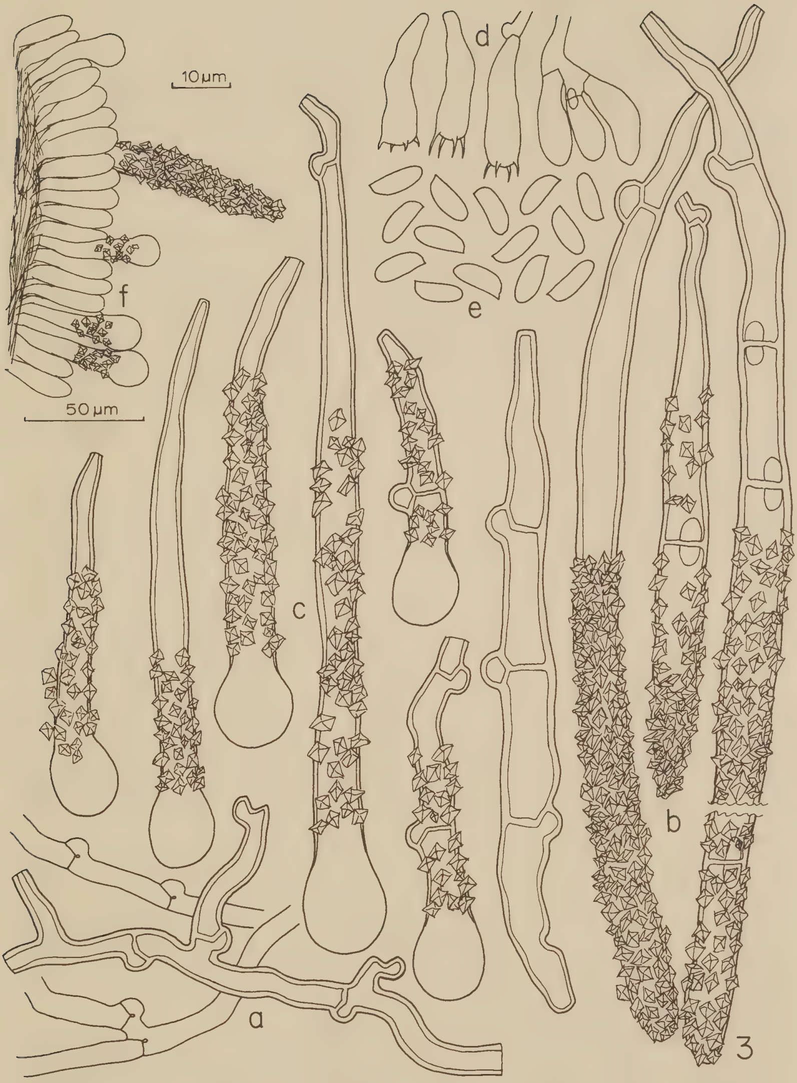
10 µm
50 µm
a
b
c
d
e
f
3

Fig. 3. *Hyphoderma nudicephalum* (MB 944). a, subicular hyphae; b, cylindric cystidia with clamps; c, capitate cystidia; d, basidia; e, basidiospores; f, hymenium.

Basidiospores short-cylindric, hyaline, smooth, negative in Melzer's reagent, 4-4.5 x 1.5-2 µm.
Type of rot - Associated with a uniform to pitted white rot of dead pines.
Specimens examined - MISSISSIPPI: MB 1098, 1100, and 1114, on *Pinus elliottii* Engelm., Chimney Point, Horn Island, Johnson County. TEXAS: MB 844, on *Pinus* sp., Village Creek at U.S. Highway 187, Hardin County.
Remarks - *Hyphodontia microspora* was collected only once in North Europe, according to Eriksson and Ryvarden (1976). A North American specimen was examined by Kurt Hjortstam, who confirmed that it agreed in all respects with the European specimen.

HYPHODONTIA ORASINUSENSIS Gilbn. & M. Blackwell. sp. nov.
Fructificatio annua, resupinata, odontoidea, pallido-bubalina vel cremeo-lutea; systema hypharum monomiticum; hyphae basalis simple-septatae, hyphae subhymenialis fibulatae; cystidia cylindricae, laeves, nonseptata vel septatae, usque ad 150 um longa et 8 um in diam; basidia clavata, 4-sterigmatibus, 14-20 x 4.5-5.5 um; basidiosporae ellipsoideae vel ovoidae, laeves, nonamyloideae, 4-4.5 (-5) x 2.5-3.5 um. Holotypus: M. Blackwell No. 2141, on *Celtis laevigata* Willd., LSU Burden Farm, Baton Rouge, LA, Oct. 20, 1983, in herb. National Fungus Collections, Beltsville, MD.
Etymology: of the Gulf Coast.
Basidiocarps annual, resupinate, soft and fragile, easily removed from substratum, effused up to 20 cm.; hymenial surface Light Buff to Ivory Yellow, odontioid, with slender, elongated to flattened teeth up to 800 um long, tapering to a fimbriate apex; subiculum soft, floccose, less than .5 mm thick; margin thinning out, soft, floccose, loosely interwoven, arachnoid at the extreme edge.
Hyphal system monomitic; basal subicular hyphae simple-septate, thin- to firm-walled, with frequent branching, 2.5-4.5 µm in diam; hyphae of upper subiculum and teeth with clamps, thin- to firm-walled, with frequent branching, 2-4.5 µm in diam.
Cystidia in tufts at apices of teeth, occasional in the hymenium, tubular, tapering to the base, not incrusted, nonseptate or with one to several simple septa, thin-walled with wall thicker toward the base, up to 150 µm long and 8 µm in diam at the broad apex, with a basal clamp.
Basidia clavate, 4-sterigmate. 14-20 x 4.5-5.5 µm, with a basal clamp.
Basidiospores ellipsoid to ovoid, hyaline, smooth, negative in Melzer's reagent, 4-4.5 (-5) x 2.5-3.5 µm.
Type of rot- Associated with a white pitted rot of dead hardwoods and conifers.
Specimens examined- LOUISIANA: MB 2141 (Holotype) and MB 2139, on *Celtis laevigata* Willd., LSU Burden Farm, Baton Rouge, East Baton Rouge Parish; MB 1526, on *Ailanthus altissima* (Mill.) Swingle, New Orleans, Orleans Parish; MB 1993, on *Quercus nigra* L., Calcasieu River, South Westlake, Calcasieu Parish; RLG 14733, on *Pinus taeda* L., Fontainebleau State Park, St. Tammany Parish.
Remarks- Basidiocarps of *H. orasinusensis* resemble those of *H. microspora* macroscopically and microscopically. The broader, more ellipsoid spores and simple-septate basal hyphae distinguish *H. orasinusensis*.

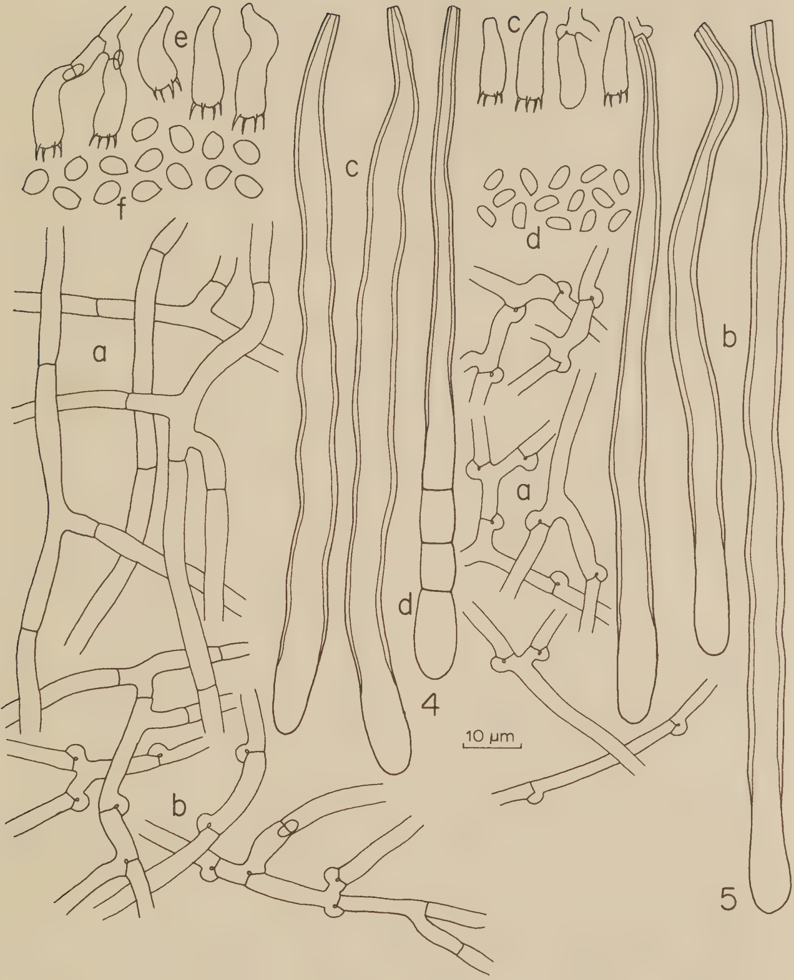

Fig. 4. *Hyphodontia orasinusensis* (MB 2141). a, simple-septate basal hyphae; b, subhymenial hyphae with clamps; c, nonseptate tubular cystidia; d, cystidium with septate apex; e, basidia; f, basidiospores. Fig. 5. *Hyphodontia microspora* (MB 844). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores.

SKVORTZOVIA FURFURELLA (Bres.) Bononi & Hjortst., In Hjortst. & Bononi, Mycotaxon 28:12. 1987.
Odontia furfurella Bres., Mycologia 17:71. 1925.

Basidiocarps annual, resupinate in small patches or effused up to 15 cm; hymenial surface white to cream colored, becoming hydnaceous, teeth simple, cylindric, some confluent, up to 1.5 mm long, apices appearing minutely fimbriate under a 30x lens; marginal areas smooth to grandinioid, loosely floccose to farinaceous under a 30x lens; subiculum whitish, soft, less than .5 mm thick.

Hyphal system monomitic; subicular hyphae loosely interwoven, thin- to firm-walled, with occasional branching, with clamps at all septa, 2.5-3 µm in diam.

Cystidia frequent in hymenium, narrowly subulate, with a rounded apex, irregular in shape, thin-walled, not incrusted, 2-3 µm in diam at the base and up to 35 µm long, projecting to 25 µm, similar hyphal ends clustered at apices of teeth.

Basidia narrowly clavate to napiform, 4-sterigmate, 12-25 x 3-4 µm, with a basal clamp.

Basidiospores narrowly allantoid, hyaline, smooth, negative in Melzer's reagent, 4.5-5 x 1-1.5 µm.

Type of rot- Associated with a white pitted to uniform rot of dead pines, also occasionally on dead oaks.

Specimens examined- GEORGIA: RLG 11856, on *Quercus* sp., Univ. of Georgia Botanical Gardens, Athens, Clarke County. LOUISIANA: MB 1462 and 1463; on *Quercus virginiana* Mill., Fontainebleau State Park, St. Tammany Parish; MB 1575, 1582 and 1589 on *Pinus taeda* L., Hammond, Tangipahoa Parish; MB 2108 and 2114, on *Pinus taeda* L., LSU Burden Farm, Baton Rouge, East Baton Rouge Parish; MB 1078, 1080 and 1084, on *Pinus palustris* Mill. LSU Burden Farm, Baton Rouge; RLG 13444 and 13450, on *Pinus taeda* L., Denham Springs, Livingston Parish; RLG 13258 and 13270 on *Pinus taeda* L., Asphodel, East Feliciana Parish; RLG 15940, on *Pinus glabra* Walt., LSU Burden Farm, Baton Rouge. MISSISSIPPI: MB 1248, on *Pinus palustris* Mill., Harrison Exp. Forest, Harrison County; MB 1048, on *Pinus glabra* Walt., Yookanookany Creek, and Highway 16, Leake County. TEXAS: RLG 13338, on *Pinus taeda* L., Steven F. Austin Univ. Forest, Nacogdoches, Nacogdoches County; MB 826 and 837, on *Pinus taeda* L., Beech Creek and Lumberton respectively, Hardin County.

Remarks- Gilbertson (1963) also reported this taxon (as *Odontia furfurella* Bres.) from Indiana, Kentucky, New York, North Carolina, Rhode Island, Tennessee, and Virginia. It has not been collected in western North America. For a discussion of generic and specific relationships see Hjortstam and Bononi (*op. cit.*).

VARARIA SPHAERICOSPORA Gilbn., Pap. Michigan Acad. Sci. 50:176. 1965.

Basidiocarps annual, resupinate, effused up to 20 cm, adherent but soft and easily scraped from the substratum with a needle; hymenial surface Chamois to Honey Yellow, smooth; subiculum soft, concolorous, very thin.

Hyphal system dimitic; subicular generative hyphae thin-walled, hyaline, negative in Melzer's reagent, with clamps, 2-3 µm in diam; thick-walled, nonseptate dichohyphidia also present.

Dichohyphidia abundant throughout subiculum and hymenial region, thick-walled, with well-defined and repeated dichotomous branching, weakly to

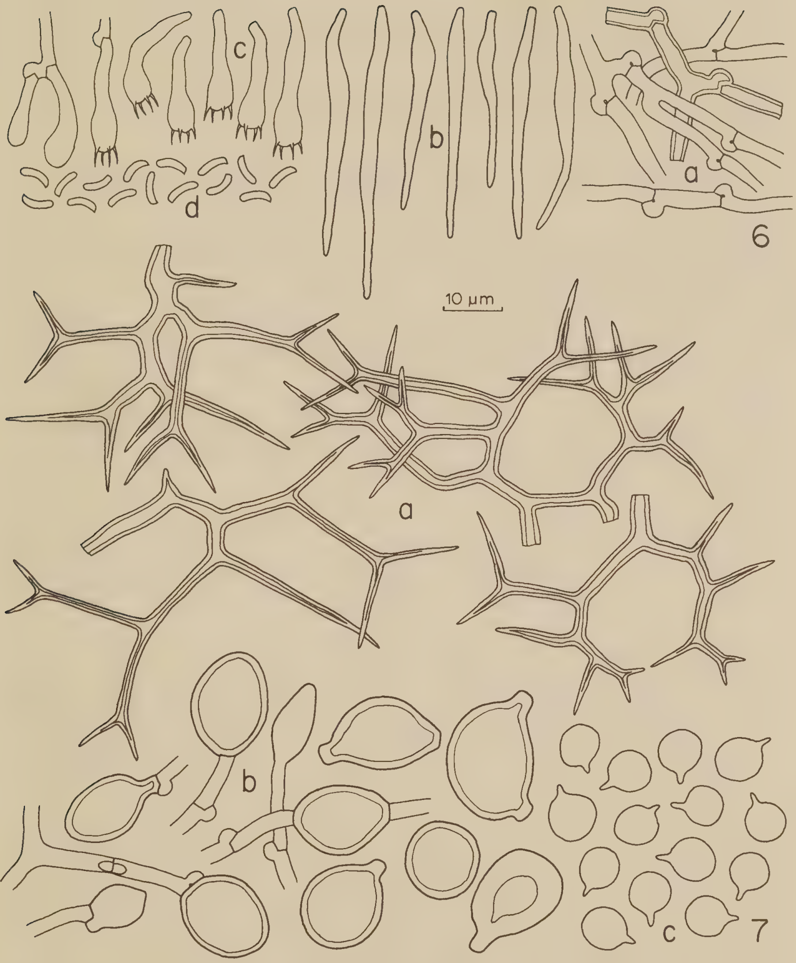

Fig. 6. *Skvortzovia furfurella* (MB 826). a, subicular hyphae; b, cystidia; c, basidia; d, basidiospores. Fig. 7. *Vararia sphaericospora* (RLG 13375). a, dichohyphidia; b, chlamydospores and hyphae with clamps; c, basidiospores.

strongly dextrinoid in Melzer's reagent, up to 5 µm in diam in larger branches, tapering to a point at the tips, tips straight, not reflexed.

Chlamydospores abundant in subiculum of both specimens cited, spherical to avoid or with asymmetrical projections representing former hyphal attachments, thick-walled at maturity, contents dextrinoid in Melzer's reagent, developing from clamped generative hyphae, hyaline and thin-walled in early stages of development, when mature up to 22 µm in longest dimension.

Gloeocystidia imbedded and obscured by dichohyphidia, thin-walled.

Basidia elongated, cylindric-clavate, 4-sterigmate, 40-45 x 6-7.5 µm, with a basal clamp.

Basidiospores spherical, hyaline, smooth, thin-walled, negative in Melzer's reagent, 7-8 (-9) µm in diam, hilar appendix conspicuous, up to 2.5 µm long.

Type of rot- Associated with a uniform white rot of dead hardwoods.

Specimens examined- LOUISIANA: MB 1455, on *Liquidambar styraciflua* L., Fontainebleau State Park, St. Tammany Parish; RLG 13375, on hardwood log, Walker, Livingston Parish.

Remarks- The original description of *V. sphaericospora* from the Okefenokee Swamp in Georgia is the only previous record of this species in North America. Boidin and Lanquetin (1975) subsequently reported *V. sphaericospora* from Africa. Chlamydospores were not mentioned in either of these two publications. Boidin et al. (1976) reported chlamydospores in cultures of *V. sphaericospora* from Africa. Boidin et al. (1980) and Boidin and Lanquetin (1984) also reported chlamydospores in basidiocarp tissue of African specimens.

ACKNOWLEDGMENTS

The authors thank Dr. J.L. Crane of the University of Illinois herbarium for the loan of the type of *Epithele capitata,* and Kurt Hjortstam of the Royal Botanic Gardens, Kew, Surrey, for examining a specimen at our request.

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TERMINOLOGY OF SPORE STATES IN UREDINALES

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In his morphologically based terminology Arthur (1905) introduced the term "pycnium" for the monokaryotic organ that some uredinologists call a spermogonium. The pycnium, an organ unique to the rusts, produces spermatia, receptive hyphae and nectar that attracts insects. It is thus analogous to an entomophilous perfect flower. To call it a spermogonium is as misleading as calling the flower an anther.

I protested (Savile, 1968) the use of "uredium" to describe the spore state commonly termed a "uredinium", or a "uredosorus" in Europe. My lesser objection, that uredium is etymologically incorrect, "uredo" having the stem "uredin-", has been accepted by various uredinologists. On publication of the Manual (Arthur, 1934) the American Phytopathological Society adopted its terminology as standard in a business meeting unattended by the mycologists who were at their own meeting (E.B. Mains, personal communication). Presumably most pathologists thought they were merely adopting a shortened term. The major objection to "uredium" is that it had a new meaning. In Arthur (1932) a "primary uredinium" became a "uredioid aecium" and a "secondary aecium" became an "aecidioid uredium". The uredium thus became a structure that followed an aecium regardless of its morphology. Morphology was abandoned, despite Arthur's claim of a morphological basis, in favor of a supposedly immutable life cycle: 0-->I-->II-->III because they are so defined by a circular argument.

The life-cycle system cannot cope with e.g. *Puccinia podophylli*, which produces aecia on leaf blades but primary telia on vascular tissue; nor can it cope with microcyclic rusts with pycnia (e.g. *Puccinia holboellii* on *Arabis*, *P. suksdorfii* on *Agoseris* and *Tranzschelia fusca* on *Anemone*).

The only "morphology" in Arthur's new system was the nuclear condition of the *initiating* mycelium: monokaryotic for aecia and dikaryotic for uredinia and telia; but all cells within the aecia are dikaryotic. If the nuclear condition were critical, there might still be a slender case for Arthur's concept. However, it has become abundantly clear that the nuclear condition does not control morphogenesis at all, in the rusts and in various plant groups; rather it controls only the morphology, and to some extent the size, of the individual cell. Morphogenesis, the orderly construction of organs, is under epigenetic control; i.e. it is directed by the somatic environment. This view was expressed emphatically by

Williams (1966, p.63), who credited Wardlaw (1955) with demonstrating that development in various plants and fungi is uniformly controlled by the somatic environment regardless of whether the cells are haploid or diploid, Actually this blanket statement must be credited to Williams, for it is in no sense a quotation from Wardlaw. Both in this book and in his earlier one (Wardlaw, 1952), Wardlaw did occasionally state the role of eipgenetic control, but without marked emphasis and clearly regarding it as common knowledge.

Recent success with *in vitro* culture of plants confirms the dominance of epigenetic control; e.g. Sangwan-Norreel *et al.* (1986) have shown that haploid cultures of various monocotyledons and dicotyledons, from anthers or ovules, permit the formation of plants comparable to those from diploid seeds.

The overwhelming importance of the somatic environment in directing sorus formation should be clear to field students of the rusts. Watching the development of *Puccinia podophylli* in spring we see that the pycnia give rise to aecia on leaf blades but to primary telia on stems and major leaf veins; and a sorus at the edge of a vein may be telial on vascular tissue but aecial on laminal parenchyma. In many rusts development depends on the precise physiological state of leaf tissue. In grass or sedge rusts we usually see several generations of uredinia before a change to telia occurs with incipient leaf senescence; but near arctic or alpine tree line only a single mixed uredinial and telial generation may occur. When *Puccinia atrofusca* occurs on some evergreen *Carices* it persists through urediniospores or amphispores, and no teliospores are produced.

The action of epigenetic control is easily studied in various autoecious eucyclic rusts. In, e.g. *Uromyces triquetrus* on *Hypericum, U. hedysari-obscuri* on *Hedysarum* and *Puccinia variabilis* on *Taraxacum*, primary aecia may be followed by uredinia, secondary aecia (without pycnia) or by both on one leaf, the fungi being very sensitive to the physiology of the host tissues. As previously noted (Savile, 1975; 1976, p.143), although *Puccinia violae* is usually orthodox in development, on a high and somewhat dry montane site (on *Viola glabella*, Vancouver I., 1190 m.s.m., Calder & MacKay 32251) its development was so telescoped that aecial cups, uredinia and telia were produced in one sorus, including teliospores in an aecial cup. If we followed the life-cycle system faithfully, all these spores would be classed as aeciospores. Such observations make nonsense of that rigid system, which, as noted above, also cannot cope with microcyclic rusts possessing pycnia: The sori when formed are, by Arthur's definition, aecia; but when the spores germinate they do so as teliospores.

Several generations of uredinologists named rust states according to their morphology with minimal confusion. Despite advances in complementary disciplines morphology remains basic to accurate descriptions of rusts, to their classification, and to making usable keys. A system that, instead of stating that aecia or uredinia may be present or absent in a genus, abandons morphology for an imaginary immutable life cycle is seriously misleading. The use of this system by Cummins and Hiratsuka (1983) in describing rust genera has added to the confusion: a genus in which some species have eliminated the aecia is stated to have two types of aecia (aecioid or uredinoid); and if any species of a genus has repeating aecia the genus is stated to have uredinoid or aecioid uredinia.

Correspondence and discussions have shown me that mycology teachers who are not primarily uredinologists have difficulty in explaining this illogical situation to their students. Recently a student, presumably more at home with a computer than with the rusts, and using the generic descriptions of Cummins and Hiratsuka, sent me a truly horrendous "final" cladogram of the rusts, in which the supposed two types of aecia or uredinia were conspicuous among many sources of confusion. It is surely high time to return to morphology and abandon fiction.

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NEW SPECIES AND NEW REPORTS OF *FLAVOPARMELIA* (LICHENIZED ASCOMYCOTINA) FROM THE SOUTHERN HEMISPHERE

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ABSTRACT : The species, *Flavoparmelia diffractaica* Elix & Johnston, *Flavoparmelia haywardiana* Elix & Johnston, *Flavoparmelia neuquenensis* Nash, Elix & Johnston, *Flavoparmelia proeuplecta* Elix & Johnston, *Flavoparmelia scabrosina* Elix & Johnston, *Flavoparmelia secalonica* Elix & Johnston and *Flavoparmelia succinprotocetrarica* Elix & Johnston are described as new. Apart from the Argentinian *F. neuquenensis*, and the New Zealand *F. haywardiana*, these species occur in Australia. *F. euplecta* is reported for the first time from Norfolk Island.

Introduction

After reducing the genus *Pseudoparmelia* (Lynge 1914; Hale 1976) to four tropical species, Hale (1986) proposed the genus *Flavoparmelia* to accommodate 17 former *Pseudoparmeliae* that contain cortical usnic acid. Species of *Flavoparmelia* (Elix, Johnston & Verdon 1986; Hale 1986) always have a black lower surface with simple rhizines, a distinct, bare, marginal zone and have larger spores than other segregates of *Pseudoparmelia s. l.* The bifusiform conidia and rotund, broad lobes further separate *Flavoparmelia* from *Relicinopsis*, the only other segregate of this group with usnic acid as the major cortical pigment (Elix, Johnston & Verdon 1986). Since then we have described further species of *Flavoparmelia* from South America (Nash, Elix & Johnston 1987; Elix & Adler 1987), and now are describing 5 new species from Australia, one from New Zealand and one from Argentina. Australia appears to be a major centre of speciation of this genus.

Throughout the present work chemical constituents were identified by thin layer chromatography (Elix, Johnston & Parker 1987, 1988), high performance liquid chromatography (Lumbsch & Elix 1985) and by comparison with authentic samples.

Flavoparmelia diffractaica Elix & Johnston sp. nov. Figure 1

Species cum thallo ut in *Flavoparmelia helmsii* sed ab hac specie acidum diffractaicum et acidum protocetraricum continente differt.
Type. Australia. South Australia. On *Casuarina*, 10 km north-east of Eden Valley along the Keyneton road, 480 m, *J. A. Elix 2267*, 21.v.1976; CBG-holotype.

Thallus foliose, corticolous, adnate, dark green to yellow-green, to 10 cm in

diameter. *Lobes* irregular, rotund, 2.0-5.0 mm wide, often crowded and imbricate, plane, the margins crenulate. *Upper surface* broadly undulating, rugose centrally, dull for the most part, emaculate, apices shiny, black margined, lacking isidia and soredia; medulla white. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* adnate, to 8 mm in diameter, disc concave at first then undulate-distorted, cinnamon brown to dark brown; margin involute at first, thick, persistent, amphithecium smooth at first but becoming rugulose; asci 8-spored, spores simple, colourless, ellipsoid, 11-14 x 6-8 µm. *Pycnidia* common, subspherical, immersed, black; conidia weakly bifusiform, 7-9 x 1 µm.
Chemistry. Cortex K-; medulla K-, C-, P+ orange ; containing usnic acid, protocetraric acid (minor), diffractaic acid (major), barbatic acid (trace) and 4-*O*-demethylbarbatic acid (trace), baeomycesic acid (trace), obtusatic acid (trace), virensic acid (± trace), unknown (trace), caperatic acid (±).

This new species is closely related to *Flavoparmelia helmsii* (Kurok. & Filson) Hale as both species have similar, adnate yellow to yellow-green thalli, which become markedly rugulose towards the thallus centre, and have related chemistries. Even so they can be separated by their chemical constituents: *F. helmsii* contains usnic acid, barbatic acid (major), 4-*O*-demethylbarbatic acid (minor) together with variable quantities of caperatic acid; *F. diffractaica* contains diffractaic acid as the major depside, plus the depsidone, protocetraric acid. As these two species maintain their chemical integrity and exhibit significant distributional differences, they are considered distinct species (Elix 1982). Furthermore, the spores of *F. diffractaica* are consistently shorter (11-14 x 6-8 µm) than those of *F. helmsii* (14-18 x 6-9 µm). *F. diffractaica* is found in the temperate areas of southern South Australia, western New South Wales, inland Western Australia and central Australia, while *F. helmsii* is restricted to the arid areas of central Australia.

Specimens Examined
NEW SOUTH WALES. On twigs, Warrumbungle National Park, *Sue Brownlie A27*, v.1969 (MEL 1023539).
SOUTH AUSTRALIA. On twigs of mallee, 12 km from Monarto South towards Langhorne Creek, Ferries-McDonald Conservation Park, Murray Basin district, 40 m, *E. M. Canning & S. Corbett 5590*, 11.xii.1982 (CBG); on fence post, Humbug Scrub, 40 km north-east of Adelaide, *John Curtis*, 9.iv.1967 (MEL 34892); on bark, lower Murray Mallee, *c*. 8 km west of Murray Bridge, on road to Kinchina, *K. Czornij 570*, 22.viii.1973 (AD 4693); on old fence posts in pasture land, Borthwick Road, 6.5 km east of Tungkillo, Mt. Lofty Ranges, 470 m, *J. A. Elix 9495*, 30.x.1981 (ANUC).
WESTERN AUSTRALIA. On bark, near Kalgoorlie, *M. F. Day*, vii. 1982 (ANUC).
NORTHERN TERRITORY. On bark of *Acacia aneura* in stream bed, north of Valley of Eagles, 5.5 km WSW of Trephina Gorge, eastern MacDonnell Ranges, *J. H. Willis s.n., pr.p.*, 2.vi.1974 (MEL 515457).

Flavoparmelia haywardiana Elix & Johnston sp. nov. Figure 2

Species cum thallo ut in *Flavoparmelia springtonensis* sed ab hac specie acidum protocetraricum continente differt.
Type. New Zealand. North Island. Gisborne: on dead *Cupressus* along the foreshore, Tolaga Bay, sea level, *J. A. Elix 10080*, 13.i.1982; CHR-holotype; CBG-isotype.

Thallus foliose, adnate on branches and trunks of trees and on dead wood, pale yellow-green, to 10 cm in diameter. *Lobes* irregular, 1.0-4.0(-5.0) mm wide, becoming laterally imbricate, ± contiguous, plane, rotund at the apices. *Upper surface* plane to ± undulating, dull to slightly shiny, ± with reticulate, white maculae towards the apices, becoming minutely wrinkled to rugose or subfaveolate within; densely sorediate, *soralia*

laminal, orbicular to subcapitate at first but coalescing and spreading over the upper surface, soredia farinose; medulla white for the most part, rarely with a yellow-orange zone adjacent to the lower cortex. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* and *pycnidia* not seen.
Chemistry. Cortex K-; medulla K-, C-, P+ brick red; pigmented lower medulla K+ purple; containing usnic acid, protocetraric acid (major), caperatic acid (±), atranorin (±), skyrin (minor), virensic acid (trace), unknown (trace).

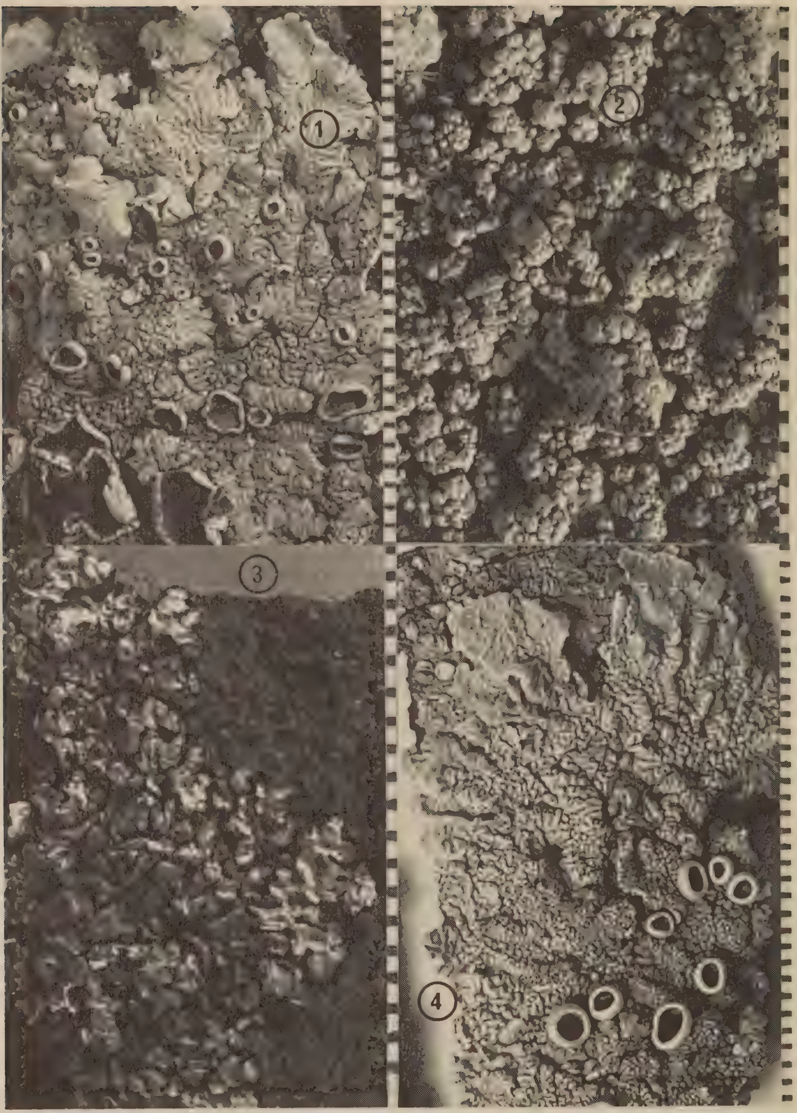
This new species appears to be related to *Flavoparmelia springtonensis* (Elix) Hale as both have similar, adnate, yellow to yellow-green thalli, a farinose-sorediate upper surface and have related medullary chemistries (i.e. they exhibit chemosyndromic variation). However, they can be separated by their chemical constituents: *F. springtonensis* contains medullary physodalic acid plus variable quantities of caperatic acid; *F. haywardiana* contains protocetraric acid and caperatic acid (±). These two species also exhibit significant distributional differences - *F. springtonensis* is widely distributed throughout south-eastern Australia, while *F. haywardiana* occurs only in New Zealand. The development of the soredia also differs in these two species: the soralia coalesce to form sorediate ridges in *F. springtonensis*, but remain smaller and suborbicular in *F. haywardiana*. This species is named in honour of the New Zealand lichenologists, Drs. Bruce and Glenys Hayward of Lower Hutt. *F. haywardiana* formerly was referred to *Pseudoparmelia pseudosorediosa* (Gyelnik) Hale (Galloway 1985), but the type of the latter taxon is conspecific with *Flavoparmelia euplecta* (Stirton) Hale.

Specimens Examined
NEW ZEALAND. North Island. South Auckland: on *Pinus* in open scrubland, trail to Cathedral Cove, Hahei, Coromandel Peninsula, 15 m, *J. A. Elix 9799,* 9.i.1982 (ANUC); on pohutukawa along the foreshore, Orakawa Bay, Waihi Beach, *J. A. Elix 10006,* 10.i.1982 (ANUC); on dead *Pinus* twigs in plantation, Fletchers River Park, 12 km north of Taupo, 360 m, *J. A. Elix 10126,* 18.i.1982 (ANUC). Taranaki: on *Eucalyptus*, Turuturu-mokai Pa site, Hawera, 90 m, *J. A. Elix 7926,* 6.v.1980 (ANUC, CHR); on *Cupressus*, Burgess Park, New Plymouth, 60 m, *J. A. Elix 7975,* 7.v.1980 (ANUC). South Island. Nelson: on exotic trees in park land, Botanic Hill Reserve, Nelson, 135 m, *J. A. Elix 7758,* 6.iv.1980 (ANUC). Westland: on dead tree, Westport Cemetery, Westport, *J. A. Elix 7299,* 27.ii.1980 (ANUC).

Flavoparmelia neuquenensis Nash, Elix & Johnston sp. nov. Figure 3

Species cum thallo ut in *Flavoparmelia glomelliferica* sed ab hac specie thallo diminuto, lobis angustioribus et acidum diffractaicum et acidum 4-*O*-demethylbarbaticum continente differt.
Type. Argentina. Neuquen Province. On rocks, 15 km south of Alumine along Río Alumine, *T. H. Nash 24, 083*, 29.ix.1985; ASU-holotype, BAFC-isotype.

Thallus foliose, saxicolous, adnate, yellow-green but darkening to olive-black in the older lobes, to 3 cm in diameter. *Lobes* irregular, 1.0-2.0 mm wide, becoming laterally imbricate, ± contiguous, rotund at the apices. *Upper surface* plane to ± undulating and wrinkled, dull to slightly shiny; pustulate-sorediate, *pustules* laminal, forming on ridges in older lobes, erumpent, forming granular soredia; medulla white. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* not seen. *Pycnidia* common, black, punctiform, immersed; conidia weakly bifusiform, 5-7 x 1-1.5 µm.
Chemistry. Cortex K-; medulla K-, C-, P-; containing usnic acid, diffractaic acid (major), 4-*O*-demethylbarbatic acid (minor), barbatic acid (trace), unknowns (trace).



Figures 1-4. New species of *Flavoparmelia*. 1, *F. diffractaica* (holotype in CBG); 2, Soralia of *F. haywardiana* (*J. A. Elix 7299* in ANUC); 3, *F. neuquenensis* (holotype in ASU); 4, *F. proeuplecta* (holotype in CBG). Scale in mm.

This new species possibly is related to *Flavoparmelia glomelliferica* Elix & Adler as both are saxicolous and have adnate, yellow to yellow-green thalli, with a pustulate-sorediate upper surface and contain medullary depsides. However, they can be separated clearly by their morphology and chemical constituents: *F. glomelliferica* has a larger thallus (5-8 cm diam.) with broader, leathery lobes (3-5 mm wide) and contains medullary glomelliferic acid plus variable quantities of caperatic acid; *F. neuquenensis* has diminutive thalli (2-3 cm diam.) with narrow, fragile lobes (1-2 mm wide) and contains diffractaic acid and 4-*O*-demethylbarbatic acid, as well as minor amounts of barbatic acid and caperatic acid (±). At present this species is known only from the type collection.

Flavoparmelia proeuplecta Elix & Johnston sp. nov. Figure 4

Species cum thallo ut in *Flavoparmelia rutidota* sed ab hac specie thallo diminuto, fragile, lobis angustioribus et euplectinum continente differt.
Type. Australia. Western Australia. On *Acacia acuminata* along roadside, adjacent to pasture, 10 km south-east of Corrigin on road to Kulin, 32°21'S, 117°53'E, *J. A. Elix 21651 & M. V. Sargent*, 19.viii.1987; CBG-holotype.

Thallus foliose, corticolous, adnate, bright yellow-green, to 8 cm in diameter. *Lobes* irregular, rotund, 2.0-3.0(-5.0) mm wide, often crowded and imbricate, plane, the margins crenulate. *Upper surface* broadly undulating, rugose centrally, dull for the most part, with reticulate, white maculae towards the apices, apices shiny, black margined, lacking isidia and soredia; medulla white for the most part, but orange-pigmented adjacent to the lower cortex. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* adnate, to 10 mm in diameter, disc concave at first then undulate-distorted, cinnamon brown to dark brown; margin involute at first, thick, persistent, amphithecium smooth at first but becoming rugose; asci 8-spored, spores simple, colourless, ellipsoid, 14-16 x 7-9 μm. *Pycnidia* common, subspherical, immersed, black; conidia weakly bifusiform to fusiform, 7-9 x 1 μm.
Chemistry. Cortex K-; medulla K-, C-, P+ brick red; pigmented lower medulla K+ red-purple; containing usnic acid, protocetraric acid (major), virensic acid (trace), caperatic acid (±), euplectin (minor), atranorin (±), unknown (trace).

This new species is closely related to *Flavoparmelia rutidota* (J.D. Hook. & Taylor) Hale as both species have similar, adnate, yellow-green thalli, which become distinctly rugose on the the upper surface of the older lobes (towards the centre of the thallus), and produce medullary protocetraric acid. However they can be separated clearly by the presence of a pigmented lower medulla (which reacts K+ red-purple) in *F. proeuplecta*. Thus both species contain usnic acid, protocetraric acid and variable quantities of caperatic acid, but *F. proeuplecta* also contains the anthraquinone, euplectin. This pigment was recognized originally in the related species *F. euplecta* (Stirton) Hale but the structure remains unknown. *F. euplecta* is considered to be the pustulate-sorediate counterpart of *F. proeuplecta*.

Some specimens of *F. rutidota* also have a pigmented medulla [e.g. the type of *Flavoparmelia jelineckii* (Krempelh.) Hale] but here the pigment is scattered throughout the medulla and does not form a continuous band adjacent to the lower cortex. Furthermore, the major pigment in *F. rutidota* is secalonic acid A, a yellow bisxanthone pigment which reacts K-, rather than the orange anthraquinone, euplectin, which reacts K+ purple. These two species also have quite different geographical distributions: *F. rutidota* is distributed throughout southern Australia and also occurs in South America and the south-western United States (Texas); *F. proeuplecta* is restricted to the dry, hinterland forest of south-western Western Australia.

Specimens Examined
WESTERN AUSTRALIA. On dead *Acacia*, Watheroo National Park, 30°18'S, 116°03'E, *M. F. Day 85/58A*, 13.ix.1985 (ANUC); on *Casuarina* along the foreshore, Lake Yealering, 32°35'S, 117°37'E, *J. A. Elix 21695 & M. V. Sargent*, 19.viii.1987 (ANUC); on bark of *Casuarina*, Jurien Bay road, 25.5 km west of Badgingara, *Rex Filson 8443*, 1.ix.1966 (MEL 27574).

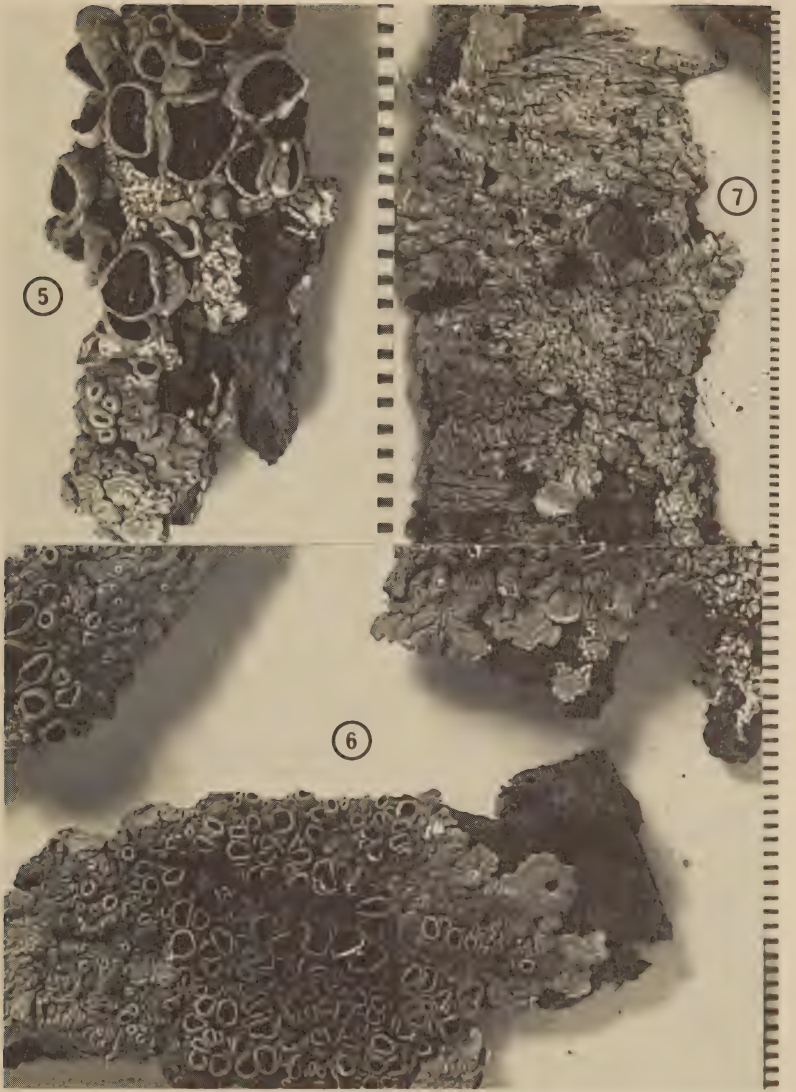
Flavoparmelia scabrosina Elix & Johnston sp. nov. Figure 5

Species cum thallo ut in *Flavoparmelia helmsii* sed ab hac specie thallo diminuto, fragile, lobis angustioribus et scabrosinum 4,4'-diacetatinum continente differt.
Type. Australia. South Australia. On dead branches of *Acacia*, Ooldea sand dunes, south of the road to Tarcoola at the eastern railway yard limit, Nullarbor Region, 30°28'S, 131°53'E, *N. N. Donner 7597*, 31.viii.1980; MEL 667489-holotype.

Thallus foliose, corticolous, adnate, yellow-green, to 4 cm in diameter. *Lobes* irregular, rotund, 1.0-3.0 mm wide, often crowded and imbricate, plane, the margins crenulate. *Upper surface* broadly undulating, rugose centrally and ultimately areolate, dull for the most part, apices shiny and ± white maculate, lacking isidia and soredia; medulla white. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* adnate, to 5 mm in diameter, disc concave at first then undulate, sometimes crowded and distorted, cinnamon brown to dark brown; margin involute at first, persistent, amphithecium smooth; asci 8-spored, spores simple, colourless, ellipsoid, 12-14 x 5-8 μm. *Pycnidia* common, subspherical, immersed, black; conidia weakly bifusiform to fusiform, 7-12 x 1 μm.
Chemistry. Cortex K-; medulla K-, C-, P-; containing usnic acid, scabrosin 4,4'-diacetate (major), caperatic acid (±), atranorin (±), unknown scabrosin derivatives (minor).

This new species is closely related to *Flavoparmelia helmsii* (Kurok. & Filson) Hale as both species have similar, adnate, yellow-green thalli which become distinctly rugulose on the upper surface of the older lobes and, eventually, areolate towards the centre. However they can be separated clearly by their medullary chemistry since *F. helmsii* contains barbatic acid (major), 4-*O*-demethylbarbatic acid (minor) together with variable quantities of caperatic acid whereas *F. scabrosina* contains scabrosin 4,4'-diacetate and caperatic acid (±). Furthermore, the thalli of *F. scabrosina* are consistently paler in colour, thinner and more fragile than those of *F. helmsii* and have smaller spores (12-14 x 5-8 μm *cf.* 14-18 x 6-9 μm). *F. scabrosina* also appears to be related to *F. diffractaica* (above) but differs chemically and in geographic distribution. *F. scabrosina* is restricted to arid central Australia and inland Western Australia.

Specimens Examined
SOUTH AUSTRALIA. On bark of *Acacia aneura*, 20 km west of Vokes Corner, 28°34'S, 130°29'E, North-West Region, *N. N. Donner 7376 pr.p.*, 23.viii.1980 (MEL 667476); on bark of *Acacia aneura*, 10 km south of Sandy Bore, 21 km south of Victory Well, Everard Ranges, *Rex Filson 15654 & Sue Filson*, 24.xi.1975 (MEL 1013831); on twigs, Flinders Ranges, *Ferd. v. Mueller*, x.1857 (MEL 7403).
WESTERN AUSTRALIA. On dead *Acacia* in open scrubland, with *Acacia* and *Eucalyptus* dominant, Bulla Bulling, 31°01'S, 120°52'E, *J. A. Elix 21733 & M. V. Sargent*, 20.viii.1987 (ANUC).
NORTHERN TERRITORY. On bark of *Acacia aneura* in stream bed, north of Valley of Eagles, 5.5 km WSW of Trephina Gorge, eastern MacDonnell Ranges, *J. H. Willis s.n., pr.p.*, 2.vi.1974 (MEL 515457).



Figures 5-7. New species of *Flavoparmelia*. 5, *F. scabrosina* (*N. N. Donner 7376* in MEL); 6, *F. secalonica* (holotype in CBG); 7, *F. succinprotocetrarica* (holotype in MEL). Scale in mm.

Flavoparmelia secalonica Elix & Johnston sp. nov. Figure 6

Species cum thallo ut in *Flavoparmelia rutidota* sed ab hac specie thallo diminuto, fragile, lobis angustioribus et acidum secalonicum A et acidum secalonicum C continente differt.
Type. Australia. Western Australia. On *Acacia acuminata* along roadside and pasture, 10 km south-east of Corrigin on road to Kulin, 32°21'S, 117°53'E, *J. A. Elix 21654 & M. V. Sargent*, 19.viii.1987; CBG-holotype.

Thallus foliose, corticolous, adnate, dark yellow-green to deep olive-green, to 4 cm in diameter. *Lobes* irregular, rotund, 1.0-3.0(-5.0) mm wide, often crowded and imbricate, plane, the margins crenulate. *Upper surface* broadly undulating, rugose centrally, dull for the most part, emaculate, apices shiny, black margined, lacking isidia and soredia; medulla yellow-pigmented throughout. *Lower surface* black with a narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* adnate, to 4 mm in diameter, disc concave, then undulate-distorted, cinnamon brown to dark brown; margin strongly involute at first, thick, persistent, amphithecium smooth; asci 8-spored, spores simple, colourless, ellipsoid, 14-16 x 6-8 μm. *Pycnidia* common, black, subspherical, immersed, ostiole raised; conidia straight, weakly bifusiform, 6-7 x 1 μm.
Chemistry. Cortex K-; medulla K-, C-, P-; containing usnic acid, secalonic acid A (major), secalonic acid C (minor), unknown secalonic acid (± trace), unknown fatty acid (± trace).

This new species is closely related to *Flavoparmelia rutidota* (J.D. Hook. & Taylor) Hale as both species have similar, adnate, yellow-green thalli and become distinctly rugulose on the upper surface of the older lobes (towards the thallus centre). However they can be separated clearly by the colour of the medulla and their chemical constituents. The medulla of *F. secalonica* is pigmented deep yellow throughout, while the medulla of *F. rutidota* is white for the most part - intermittent yellow flecks or a thin, yellow zone adjacent to the lower medulla are observed only infrequently. *F. rutidota* contains usnic acid and protocetraric acid plus variable quantities of caperatic acid, while *F. secalonica* contains usnic acid, secalonic acid A and secalonic acid C. Furthermore, the thalli of *F. secalonica* are consistently darker in colour, are thinner and more fragile than those of *F. rutidota*. *F. secalonica* is restricted to inland areas of south-western Western Australia.

Specimens Examined
WESTERN AUSTRALIA. *c*. 60 km west of Coolgardie, *G. C. Bratt 67/511* (HO 44307); on *Acacia acuminata* trunks with a southerly aspect, 16 km south-east of Corrigin on road to Kulin, *K. Donovan UWA 709,* 19.viii.1970 (PERTH); on *Santalum* in open scrubland, with *Acacia* and *Eucalyptus* dominant, 4 km east of Bulla Bulling, 31°01'S, 120°53'E, *J. A. Elix 21726 & M. V. Sargent*, 20.viii.1987 (ANUC); on dead branch of *Acacia*, Queen Victoria Rock, 50 km south of Coolgardie, *Rex Filson 8886*, 16.ix.1966 (MEL 27572); 4 km west of Quairading, *A. S. George L18*, 22.v.1960 (MEL 1020393); Bulla Bulling, between Coolgardie and Southern Cross, *R. T. M. Pescott*, 28.ix.1965 (MEL 1025961).

Flavoparmelia succinprotocetrarica Elix & Johnston sp. nov. Figure 7

Species cum thallo ut in *Flavoparmelia euplecta* sed ab hac specie acidum succinprotocetraricum et acidum fumarprotocetraricum continente differt.
Type. Australia. Queensland. On branch of *Araucaria* in rainforest gully; Kroombit Tops State Forest, *c*. 700 m, 24°22'S, 151°00'E, *R. W. Rogers 7926*, 3.ix.1985; MEL -holotype.

Thallus foliose, corticolous or saxicolous, adnate, pale yellow-green, to 5 cm in diameter. *Lobes* irregular, 1.0-3.0(-5.0) mm wide, becoming laterally imbricate, ± contiguous, plane, rotund at the apices. *Upper surface* plane to ± undulating, dull to slightly shiny, with reticulate, white maculae towards the apices; sorediate, *soralia* laminal, erumpent-pustulate, subcapitate at first but coalescing and spreading over the upper surface, soredia granular; medulla white for the most part, but with a yellow-orange zone adjacent to the lower cortex. *Lower surface* black with a very narrow, naked, brown rim, sparsely rhizinate, rhizines short, simple or tufted at the apices, concolorous with the lower surface. *Apothecia* not seen. *Pycnidia* rare, black, punctiform, immersed; conidia weakly bifusiform, 4-6 x 1 μm.
Chemistry. Cortex K-; medulla K-, C-, P+ brick red; pigmented lower medulla K+ claret; containing usnic acid, succinprotocetraric acid (major), fumarprotocetraric acid (trace), protocetraric acid (minor), caperatic acid (±), atranorin (±), euplectin (minor), virensic acid (trace), unknown (trace).

This new species is closely related to *Flavoparmelia euplecta* (Stirton) Hale as both have similar, adnate, yellow to yellow-green thalli, a granular-sorediate upper surface and a medulla pigmented (adjacent to the lower cortex) with the anthraquinone, euplectin. However, they can be separated clearly by their chemical constituents: *F. euplecta* contains medullary protocetraric acid plus variable quantities of caperatic acid; *F. succinprotocetrarica* contains succinprotocetraric acid and fumarprotocetraric acid, as well as minor amounts of protocetraric acid and caperatic acid (±). Since these two species maintain their chemical integrity - even when sympatric - and exhibit significant distributional differences they are considered distinct species (Elix 1982). Furthermore, the thalli of *F. succinprotocetrarica* are consistently paler in colour, thinner and more fragile than those of *F. euplecta*. *F. euplecta* is widely distributed throughout eastern Australia and is found also on Norfolk Island, while *F. succinprotocetrarica* is restricted to south-eastern Queensland.

Specimens Examined
QUEENSLAND. On mangroves along the foreshore, Coochiemudlo Island, Moreton Bay, *J. A. Elix 10219,* 9.v.1982 (ANUC); on rocks in road cutting with a southerly aspect in remnant wet sclerophyll forest, junction of Mt. Nebo-Samford PEI road, Mt. Glorious, *c*. 520 m, 27°21'S, 152°46'E, *J. Johnston 1403,* 28.viii.1984 (ANUC).

New Record

Flavoparmelia euplecta (Stirt.) Hale
This species has previously been reported from Australia.
Chemistry. Cortex K-; medulla K-, C-, P+ brick red; pigmented lower medulla K+ claret; containing usnic acid, protocetraric acid (major), caperatic acid (±), atranorin (±), euplectin (minor), virensic acid (trace), unknown (trace).

Specimens Examined
NORFOLK ISLAND. On dead log, Mt. Pitt Reserve, near Broken Pine, 29°01S, 167°56'E, 220 m, *J. A. Elix 18352 & H. Streimann*, 10.xii.1984 (ANUC); on *Elaeodendron*, Mt. Pitt Reserve, track at end of Selwyn Pine Road, 29°01'S, 167°56'30"E, 215 m, *J. A. Elix 18738 & H. Streimann*, 10.xii.1984 (ANUC); on volcanic rocks in open pasture land, "The Cockpit", Cascade Creek Valley, 29°01'S, 167°58'E, 35 m, *J. A. Elix 18787 & H. Streimann*, 10.xii.1984 (ANUC); on *Citrus limon*, in regrowth rainforest, Mt. Pitt Reserve, just south of summit of Mt. Pitt, 29°01'S, 167°56'E, 220 m, *J. A. Elix 18815 & H. Streimann*, 10.xii.1984 (ANUC); on volcanic rocks in Araucaria dominated grassland, Bumboras Reserve, 29°03'30"S, 167°56'30"E, 10 m, *J. A. Elix 19269 & H. Streimann*, 10.xii.1984 (ANUC); on volcanic rocks with a southerly aspect in the open, Upper Long Valley, Philip Island, 29°07'30"S, 167°57'E, 40 m, *J. A. Elix 18501 & H. Streimann*, 10.xii.1984 (ANUC).

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NEW COMBINATIONS IN THE LICHEN GENUS XANTHOPARMELIA (ASCOMYCOTINA: PARMELIACEAE)

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Abstract: The following new combinations are proposed in the lichen genus *Xanthoparmelia*: *X. amableana* (Gyel.) Hale, *X. angustiphylla* (Gyel.) Hale, *X. bibax* (Brusse) Hale, *X. ceresina* (Vainio) Hale, *X. clivorum* (Brusse) Hale, *X. coloradoensis* (Gyel.) Hale, *X. convexula* (Müll. Arg.) Hale, *X. coreana* (Gyel.) Hale, *X. desertorum* (Elenkin) Hale, *X. endochrysea* (Müll. Arg.) Hale, *X. felkaensis* (Gyel.) Hale, *X. geesterani* (Hale) Hale & Elix, *X. inuncta* (Brusse) Hale, *X. lavicola* (Gyel.) Hale, *X. leonora* (Massalongo) Hale, *X. marroninipuncta* (Brusse) Hale, *X. monticola* (Dey) Hale, *X. neoconspersa* (Gyel.) Hale, *X. planilobata* (Gyel.) Hale, *X. pseudohungarica* (Gyel.) Hale, *X. punctulata* (Gyel.) Hale, *X. spargens* (Brusse) Hale, *X. sublaevis* (Coutinho) Hale, *X. unctula* (Brusse) Hale, and *X. xizangensis* (Wei) Hale. A new name, *X. krogiae* Hale & Elix, is proposed for *Pseudoparmelia endochromatica* Krog & Swinsc.

Xanthoparmelia amableana Hale, comb. nov.

Parmelia amableana Gyel., Fedde Repert. Sp. Nov. 36:152. 1934. Type collection: Guadalupe, Mexico, *Arsène* 653 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).

Chemistry: Stictic, constictic, norstictic, and usnic acids.

This species is characterized by dense, globose to irregularly inflated, dark-tipped erumpent isidia. A comparable species in Argentina, *X. wrightiana* Nash, Elix & Johnst., has broader lobes and unbranched, pale-tipped, erumpent isidia.

Xanthoparmelia angustiphylla (Gyel.) Hale, comb. nov.

Parmelia conspersa var. *angustiphylla* Gyel., Fedde Repert. Sp. Nov. 29:153. 1931. Type collection: Mt. Csóványos, Diósjenö, Nógrád, Hungary, *Gyelnik* s.n., 24 April 1926 (BP, lectotype).

Parmelia angustiphylla (Gyel.) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 30:124. 1936.

Chemistry: Stictic, constictic, norstictic acid, associated satellite substances (±), and usnic acid.

This species is the presumptive nonisidiate morph of the much more common *X. conspersa* (Ach.) Hale. Represented by only a few collections in Europe, it is most common in eastern North America, where it had been previously identified with *X. hypopsila* (Müll. Arg.) Hale, now considered to be a South American species with sparse rhizines and a weakly convoluted lower surface, occurring primarily on soil.

Xanthoparmelia bibax (Brusse) Hale, comb. nov.

Parmelia bibax Brusse, S. Afr. Jour. Bot. 52:105. 1986. Type collection: 17 km W of Citrusdal, top of Middelberg Pass, elev. 1100 m, Cape Province, S. Africa, Grid 3219 AA, *F. Brusse* 3045, 2 May 1981 (PRE, holotype; LD, isotype).

Chemistry: Salazinic and usnic acids, chalybaeizans unknown.

This lichen is confined to arid Namaqualand in western Cape Province and characterized by the short pruinose lobes and pale lower surface.

Xanthoparmelia ceresina (Vainio) Hale, comb. nov.

Parmelia ceresina Vainio in v. d. Byl, Ann. Univ. Stellenbosch 9A:13. 1931. Nomen nudum.

Parmelia ceresina Vainio in Lynge, Rev. Bryol. Lichenol. 10:87. 1937. Type collection: Ceres, Cape Province, South Africa, *Leslie* 474 (TUR, lectotype).

Chemistry: Fumarprotocetraric, succinprotocetraric, physodalic and usnic acids.

Known only from Table Mountain and the nearby Ceres region in South Africa, *X. ceresina* is close to the far more common *X. phaeophana* (Stirton) Hale. However, it lacks maculae and is so adnate that it cannot be removed easily from the rock substrate. The Australian *X. pertinax* (Kurok. & Fils.) Elix & Johnst. is a larger lichen lacking physodalic acid.

Xanthoparmelia clivorum (Brusse) Hale, comb. nov.

Parmelia clivorum Brusse, Bothalia 15:315. 1984. Type collection: Witelskloof, 3 km W of Olyvenboskraal, Cape Province, South Africa, Grid 3218·BD, *Brusse* 3069, 2 May 1981 (PRE, holotype).

Chemistry: Lecanoric and usnic acids.

This unique species is known only from the type locality, under the overhang of a large sandstone cliff exposed to the low-lying winter mists. It is apparently related to nonisidiate *X. namaquensis* Hale, a widespread species farther north in Namaqualand.

Xanthoparmelia coloradoensis (Gyel.) Hale, comb. nov.

Parmelia conspersa var. *coloradoensis* Gyel., Fedde Repert. Sp. Nov. 29:287. 1931. Type collection: Caribeur, Colorado, U.S.A., *Clokey* 14, 18 Feb. 1916 (US, lectotype; BP, isolectotype).

Parmelia imitans var. *coloradoensis* (Gyel.) Gyel., Fedde Repert. Sp. Nov. 35:372. 1935.

Parmelia phaeophana f. *coloradoensis* (Gyel.) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 31:35. 1938.

Chemistry: Salazinic, consalazinic and usnic acids.

This is the most widespread *Xanthoparmelia* in western North America, previously identified with "*X. stenophylla*" (=*X. somloensis* (Gyel.) Hale) or *X. taractica* (Kremplh.) Hale, a soil lichen occurring only as far north as Mexico The degree of adnation varies widely but in general the species can be collected free of the rock substrate. Tightly adnate *X. lineola* (Berry) Hale, also very common in western North America, has narrower lobes (1-2 vs. 1.5-3 mm) and is closely related.

Xanthoparmelia convexula (Müll. Arg.) Hale, comb. nov.

Parmelia convexula Müll. Arg., Proc. Roy. Soc. Edinburgh 11:458. 1882. Type collection: Socotra, *Balfour* s.n. (G, lectotype).

Xanthoparmelia karamojae Krog and Swinscow, Lichenologist 19:425. 1987. Type collection: 8 km S of Angoremoru, Pian County, Karamoja Distr., Uganda, *Swinscow* 2U33/1-1 (BM, holotype; O, US, isotypes).

Chemistry: Stictic, constictic and usnic acids.

The type specimen of *Parmelia convexula* is scrappy but can be distinguished by the adnate habit, pale lower surface, lack of isidia, short subirregular lobes, and chemistry, a combination of characters shared by *X. karamojae*. The type was probably collected at higher elevations in Socotra, corresponding in fact to the elevations at which *X. karamojae* was collected in Uganda.

Xanthoparmelia coreana (Gyel.) Hale, comb. nov.

Parmelia coreana Gyel., Fedde Repert. Sp. Nov. 29:280. 1931. Type collection: Palto Island, Korea, *Faurie* 4526 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).

Chemistry: Salazinic and usnic acids.

The barely erumpent isidia, consistently dark brown lower surface and faintly white-maculate surface distinguish this East Asian species from *X. mexicana* (Gyel.) Hale.

Xanthoparmelia desertorum (Elenkin) Hale, comb. nov.

Parmelia molliuscula f. *desertorum* Elenkin, Acta Hort. Petropol. 19:21. 1901. Type collection: Cherulun River, Mongolia, *Palibin* s.n. in 1899 (LE, not seen).

Parmelia desertorum (Elenkin) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 31:6. 1938.

Parmelia desertorum f. *neodesertorum* Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 31:6. 1938. Illegitimate name for f. *typica* (=f. *desertorum*).

Parmelia taractica var. *vagans* f. *desertorum* (Elenkin) Poelt and Vezda, Bibliotheca Lich. 16:223. 1981. Illegitimate combination. Basionym not cited.

Chemistry: Salazinic and usnic acids.

Long recognized by eastern European lichenologists, this vagrant lichen is the free-growing morphotype of *X. camtschadalis* (Ach.) Hale.

Xanthoparmelia endochrysea (Müll. Arg.) Hale, comb. nov.

Parmelia adpressa var. *endochrysea* Müll. Arg., Flora 62:289. 1879. Type collection: Gumango, distr. Bendo apud genetes Nyamnyam Africae centrali-orientalis, *Schweinfurth* s.n. (G, lectotype; BM, M isotypes).

Parmelia endochrysea (Müll. Arg.) Gyel., Fedde Repert. Spec. Nov. Regn. Veg. 29:288. 1931.

Xanthoparmelia hedbergii Knox in Knox and Brusse, Jour. S. Afr. Bot. 49:152. 1983. Type collection: Olkaria area, S of Lake Naivasha, Rift Valley, Kenya, *Hedberg* s.n., *Flora of Kenya* 6204d (UPS, holotype; US, isotype).

Chemistry: Hypoprotocetraric, 4-O-demethylnotatic and usnic acids.

This species belongs to the *X. weberi* group and represents the tightly adnate morphotype. It is known only from two collections. The very poor type specimen has a yellowish medulla, apparently due to discoloration during preservation. It is mixed with a *Melanelia* species which has a deep orange-red medulla. Isolectotype specimens in BM and M have the same morphology but contain no lichen substances other than usnic acid.

Xanthoparmelia felkaensis (Gyel.) Hale, comb. nov.

Parmelia conspersa var. *felkaensis* Gyel., Magy. Bot. Lapok 29:32. 1930. Type collection: Felkai vizesés, Com. Szepes, Magas-Tátra, Hungary, *Timkó* 3618, 1 Aug. 1917 (BP, lectotype).

Parmelia conspersa f. *alpigena* Suza, Acta Bot. Bohem. 9:26. 1930. Type collection: Lake Batizovské, Vysoké Tatry, Czechoslovakia, *Suza* s.n., Aug. 1924 (PRM, lectotype).

Parmelia conspersa f. *felkaensis* (Gyel.) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 30:123. 1936.

Chemistry: Salazinic and usnic acids.

This species is obviously related to *X. somloensis* (Gyel.) Hale but lacks white maculae on the surface, has relatively short, narrow, congested, almost inflated lobes and a distinctive pulvinate growth habit. It is known only from the high-elevation alpine zones of the Tatra Mountains.

Xanthoparmelia geesterani (Hale) Hale and Elix, comb. nov.

Parmelia geesterani Hale, Bryol. 75:344. 1972. Type collection: Waterkloof, Pretoria, Transvaal, South Africa, *Maas Geesteranus* 6405, 2 Oct. 1949 (L, holotype; LD, US, isotypes).

Pseudoparmelia geesterani (Hale) Hale, Phytologia 29:190. 1974.

Chemistry: Salazinic and usnic acids.

While I originally described this rare lichen as an atranorin-containing *Pseudoparmelia*, Dr. J. A. Elix has found usnic acid in the cortex. It has typical erumpent globose isidia and is known from several collections on dolerite pebbles in Transvaal, South Africa.

Xanthoparmelia inuncta (Brusse) Hale, comb. nov.

Parmelia inuncta Brusse, Mycotaxon 17:187. 1987. Type collection: SW slope of Ruitersberg, Robinsons Pass, Cape Province, South Africa, *Brusse* 4810, 4 Feb. 1986 (PRE, holotype; BM, LD, US, isotypes).

Chemistry: Constipatic, protoconstipatic, dehydroconstipatic and usnic acids.

This rare species corresponds to be the tightly adnate morphotype of *X. subnigra* Hale.

Xanthoparmelia krogiae Hale and Elix, nom. nov.

Pseudoparmelia endochromatica Krog and Swinsc., Lichenologist 19:421. 1987. Based on *Parmelia adplanata* Müll. Arg., 1885:502 (not *Parmelia applanata* Fée, 1925:126 (=*Dirinaria*) nor *X. endochromatica* Hale, Mycotaxon 27:574. 1986).

Parmelia adplanata Müll. Arg., Flora 68:502. 1885. Type collection: Near Mombossa, Zanzibar, *Hildebrandt* 1962 p.p. (G, lectotype; FH, isolectotype).

Parmelia adplanata f. *isidiigera* Müll. Arg., Flora 68:502. 1885. Type collection: Near Mombassa, Zanzibar, *Hildebrandt* 1962 p.p. (G, lectotype).

Parmelia adplanata var. *isidiigera* (Müll. Arg.) Dodge, Ann. Mo. Bot. Garden 46:59. 1959.

Chemistry: Fumarprotocetraric (minor), succinprotocetraric (major), protocetraric (major), and usnic acids, unknown secalonic acid pigment (det. by Dr. J. A. Elix).

This species is very close to well-known *X. subramigera* (Gyel.) Hale but the medulla is uniformly pale salmon-yellow. I first considered the pigment to be an artefact of preservation, but it is a lichen substance. According to Krog (in litt.), the species has not been recollected in lowland Kenya.

Xanthoparmelia lavicola (Gyel.) Hale, comb. nov.

Parmelia lavicola Gyel., Fedde Repert. Sp. Nov. 36:157. 1934. Type collection: La Estrella, environs of Mexico, Mexico, *Amable* 600 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).

Parmelia kurokawae Hale, Bryologist 70:418. 1967. Type collection: 2.5 mi E of Piedmont Butte, Meade Co., South Dakota, U.S.A., *Wetmore* 10360b (MSC, holotype; US, isotype).

Xanthoparmelia kurokawae (Hale) Hale, Phytologia 29:488. 1974.

Chemistry: Psoromic, norpsoromic and usnic acids.

The isidia of this chemically unusual species are subglobose to subcylindrical and barely to quite distinctly erumpent. It is known from southwestern United States and Mexico, as well as in the Andes in Ecuador.

Xanthoparmelia leonora (Massalongo) Hale, comb. nov.

Parmelia leonora Sprengel ex Massalongo, Mem. Imp. Reale Ist. Ven. Sci. Lett. Arti 10:51. 1861.

Parmelia leonora var. *platyphylla* Flotow ex Massalongo, Mem. Imp. Reale Ist. Ven. Sci. Lett. Arti 10:51. 1861. [=*P. leonora* var. *leonora*]. Type collection: Cape of Good Hope, South Africa, *Wawra* s.n.(VER, specimen "B" (as *P. australis* var. *platyphylla*), lectotype).

Parmelia leonora var. *multifida* Flotow ex Massalongo, Mem. Imp. Reale Ist. Ven. Sci. Lett. Arti 10:51. 1861. Type collection: Cape of Good Hope, South Africa, *Wawra* s.n. (VER, specimen "A" (as *P. australis* var. *stenophylla*), lectotype).

Xanthoparmelia acrita Knox and Hale in Hale, Mycotaxon 27:564. 1986. Type collection: Ceres Nature Reserve at Michells Pass, about 1.5 km SW of Ceres on Hwy R46, Cape Province, South Africa, Grid 3319 AD, *Hale* 72031, 24 Jan. 1986 (US, holotype; PRE, isotype).

Chemistry: Fumarprotocetraric, succinprotocetraric and usnic acids.

I recently examined Massalongo's original specimens and was able to clarify the status of this common soil lichen in Cape Province. It is related to *X. phaeophana* but lacks white maculae, is smaller and more narrow lobed, and has weakly convoluted lobes with uniformly distributed, often projecting rhizines.

Xanthoparmelia marroninipuncta (Brusse) Hale, comb. nov.

Parmelia marroninipuncta Brusse, Bothalia 15:315. 1984. Type collection: Uitspannings River Pass, 40 km NW of Merweville, Cape Province, South Africa, Grid 3221 CA, *Brusse* 3417, 2 August 1981 (PRE, holotype; LD, isotype).

Chemistry: Protocetraric and usnic acids, anthraquinone pigment.

The curious blackish spots on the surface of this widespread South African lichen are underlain by pockets of a deep purple anthraquinone. On TLC plates I could demonstrate one of the anthraquinones (no. 2) that also occurs in *X. endomiltoides* (Nyl.) Hale.

Xanthoparmelia monticola (Dey) Hale, comb. nov.

Parmelia monticola Dey, Castanea 39:361. 1974. Type collection: Craggy Dome, Buncombe Co., North Carolina, U.S.A., *Dey* 1509 (DUKE, holotype).

Parmelia constrictans f. *inactiva* Bouly de Lesdain ex Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 29:31. 1935. Type collection: Salazar, Mexico, *Amable* 257, 13 April 1925 (BP, lectotype; designated type in Bouly de Lesdain destroyed).

Xanthoparmelia monticola (Dey) Hale in Egan, Bryol. 90:162. 1987. Invalidly published combination without citation of the basionym.

Chemistry: Fumarprotocetraric, protocetraric, physodalic, constipatic, protoconstipatic (±), and usnic acids (det. J. A. Elix).

This high-elevation lichen, previously thought to be endemic to the southern Appalachian Mountains, includes – with some hesitation – a specimen described by Gyelnik from Mexico, identical chemically but with somewhat narrower lobes.

Xanthoparmelia neoconspersa (Gyel.) Hale, comb. nov.

Parmelia neoconspersa Gyel., Fedde Repert. Sp. Nov. 36:161. 1934. Type collection: Canon Sub, environs of Las Vegas, New Mexico, U.S.A., *Brouard* 20681, 29 April 1929 (BP, lectotype; designated type in Bouly de Lesdain herbarium destroyed).

Chemistry: Stictic, constictic, norstictic and usnic acids.

This rare New Mexican species may be considered the tightly adnate morphotype of *X. angustiphylla* (Gyel.) Hale. The dark yellow-green thallus color and the bullate-rugose center differentiate it from the Australian-S. African *X. bicontinens* Elix & Nash.

Xanthoparmelia planilobata (Gyel.) Hale, comb. nov.

Parmelia conspersa f. *planilobata* Gyel., Ann. Mycol. 36:275. 1938. Type collection: Little Besuque, Santa Fe, New Mexico, U.S.A., *Arsène* 22298, 1 Aug. 1935 (BP, lectotype).

Chemistry: Stictic, constictic, norstictic, and usnic acids.

Only several collections of this previously overlooked lichen have been made, all in New Mexico. It is related to the Australian *X. tegeta* Elix & Johnst., a saxicolous species, but the lower surface is rugose and nearly bare.

Xanthoparmelia pseudohungarica (Gyel.) Hale, comb. nov.

Parmelia convoluta var. *pseudohungarica* Gyel., Fedde Repert. Sp. Nov. 29:285. 1931. Type collection: Vácz, Comit. Pest, Hungary, *Boros* s.n. (BP, lectotype).

Parmelia pseudohungarica (Gyel.) Gyel., Fedde Repert. Sp. Nov. 30:217. 1932.

Parmelia conspersa var. *pulvinaris* Zahlbr. in Fl. Hung. Exs. Cent. VII:618. 1925. Type: Alpar, Comit. Pest, Hungary, *Timkó* s.n. (W, lectotype; BM, BP, H, L, LD, M, UPS, US, isolectotypes). Nomen nudum.

Parmelia stenophylla f. *pulvinaris* (Zahlbr.) Szatala, Magy. Bot. Lapok 1929:78. 1929.

Parmelia pulvinaris (Zahlbr.) Gyel., Fedde Repert. Sp. Nov. 29:155. 1932. Nomen nudum.

Parmelia pulvinaris var. *hungarica* Gyel., Fedde Repert. Sp. Nov. 29:156. 1932. Type collection: Vasad, Pótharaszti, Comit. Pest, Hungary, *Gyelnik* s.n. (BP, lectotype).

Parmelia pulvinaris var. *terricola* Gyel., Fedde Repert. Sp. Nov. 29:155. 1932. Type collection: Near Jutas, Veszprém, Hungary, *Gyel.* s.n. (BP, lectotype; H, isolectotype).

Parmelia pseudohungarica var. *vacensis* Gyel., Fedde Repert. Sp. Nov. 30:217. 1932. Illegitimate name for *P. convoluta* var. *pseudohungarica* Gyel.

Parmelia pseudohungarica (Gyel.) Gyel. in Servit and Klement, Vest. Kr. Ceské Spol. Nauk 2:31. 1938. Superfluous combination.

Parmelia pulvinaris f. *lacinulata* Gyel. in Servit and Klement, Vest. Kr. Ceské Spol. Nauk 2:31. 1938. 1932:31. Type collection: Kaadner Burberg, Czechoslovakia, *Klement* s.n. Nomen nudum with no description.

Parmelia laxa var. *terricola* Gyel., Fedde Repert. Sp. Nov. 35:372. 1934. Nomen illeg. without citation of basionym.

Parmelia laxa var. *pulvinaris* (Zahlbr.) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 29:26. 1935.

Parmelia taractica var. *pseudohungarica* (Gyel.) Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 30:128. 1936.

Parmelia conspersa f. *subterricola* Gyel., Ann. Hist. Nat. Mus. Nat. Hung. 30:123. 1936. Based on *Parmelia pulvinaris* f. *terricola* Gyel.

Parmelia conspersa var. *pulvinaris* Zahlbr. ex Gyel., *Lichenotheca Parva* 31, 1937. Type collection: Praemetricum, Szikrapuszta, near Alpar, Comit. Pest, Hungary, *Timkó* s.n. (BP, lectotype).

Parmelia imitans f. *verrucosa* Gyel., Ann. Mycol. 36:280. 1938. Type collection: Roquehaute, Hérault, France, *Augustin* 29 (BP, lectotype).

Parmelia phaeophana f. *verrucosa* (Gyel.) Gyel., Fedde Repert. Sp. Nov. 44:35. 1938.

Parmelia taractica var. *pulvinaris* (Zahlbr.) Poelt and Vezda, Bibliotheca Lich. 16:222. 1981. Illegitimate combination; basionym not cited.

Chemistry: Salazinic, consalazinic (±), and usnic acids.

This largely Hungarian lichen is related to both *X. somloensis* (Gyel.) Hale, a saxicolous lichen with sublinear lobes, and soil-inhabiting *X. subdiffluens* (Gyel.) Hale, which has broad, strap-shaped lobes. By contrast, *X. pseudohungarica*, a terricolous lichen common on the sterile soils south of Budapest, has subconvoluted, short marginally crenate or laciniate lobes.

Xanthoparmelia punctulata (Gyel.) Hale, comb. nov.

Parmelia punctulata Gyel., Fedde Repert. Sp. Nov. 43:85. 1938. Type collection: Estancita, Prov. Cordoba, Argentina, *Hosseus* 102 (BP, lectotype).

Xanthoparmelia argentinensis Nash, Elix and Johnston, Mycotaxon 28:288. 1987. Type collection: 3 km E of Cacheuta, Provincia de Mendoza, Argentina, *Nash* 23915 (ASU, holotype; ANUC, BAFC, BM, CTES, US, isotypes).

Chemistry: Salazinic and usnic acids.

This saxicolous species is common in Argentina. The dense globose isidia are similar to those of *X. cordilleriana* (Gyel.) Elix & Johnst., which has a brown lower surface. The type is mixed with sorediate *X. ulcerosa* (Zahlbr.) Hale, and Gyel. apparently considered them to be part of the same plant.

Xanthoparmelia spargens (Brusse) Hale, comb. nov.

Parmelia spargens Brusse, Bothalia 15:318. 1984. Type collection: Seven Weeks Poort, Cape Province, South Africa, Grid 3321 AD, *Brusse* 3481, 8 May 1981 (PRE, holotype; LD, isotype).

Chemistry: Two unidentified fatty acids, usnic acid.

This lichen is most common in Natal but occurs throughout South Africa. The isidia tend to be subglobose but not strongly erumpent. The fatty acids are unique in the genus, close to protolichesterinic acid.

Xanthoparmelia sublaevis (Coutinho) Hale, comb. nov.

Parmelia sublaevis Coutinho, Lich. Lusit. Herb. Univ. Olisip. Cat. 71. 1916. Type collection: Ad rupes syeniticas in Algarbiorum, Serra de Foia, Portugal, *Mendes* s.n., Sep. 1915 (LISU, lectotype).

Parmelia conspersa var. *hypoclysta* Nyl., Syn. Lich. 391. 1860. Type collection: Rio Frio, Madera, Spain, *Mandon* 10 (H-Nyl. herb. no. 34750, lectotype; G, isolectotype).

Parmelia taractica f. *hypoclysta* (Nyl.) Poelt and Vezda, Bibliotheca Lich. 16:222. 1981. Illegitimate combination. No basionym cited.

Chemistry: Salazinic, consalazinic, and usnic acids.

Tavares (Port. Acta Biol. ser. B, 1:84. 1945) examined the type of this poorly known species but reached no conclusion on its identity. As far as I can tell, it is restricted to the Iberian peninsula and Sardinia and can be separated from *X. somloensis* (Gyel.) Hale by the broader, more subirregular lobes, more adnate habit, and lack of distinct maculae.

Xanthoparmelia unctula (Brusse) Hale, comb. nov.

Parmelia unctula Brusse, Bothalia 15:319. 1984. Type: Seven Weeks Poort, Cape Province, South Africa, Grid 3321 AD, *Brusse* 3582 (PRE, holotype; LD, isotype).

Chemistry: Constipatic, protoconstipatic, dehydroconstipatic and usnic acids.

This rare South African species is equivalent to the tightly adnate morph of *X. subdecipiens* (Vainio) Hale.

Xanthoparmelia xizangensis (Wei) Hale, comb. nov.

Parmelia tinctina var. *xizangensis* Wei, Acta Mycol. Sinica 2:223. 1983. Type collection: Xizang (Tibet), China, *Zong et al.* 218-1, 1 June 1976 (PE, holotype).

Chemistry: salazinic, consalazinic, and usnic acids.

This is the only strongly maculate species in the genus with isidia. While superficially similar, *X. tinctina* (Mah. & Gill.) Hale has a continuous upper surface and globose isidia.

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NOTES ON HYPHOMYCETES. LIX. CURVULARIA BANNONII SP. NOV., AN UNDESCRIBED LEAF PATHOGEN OF JACQUEMONTIA TAMNIFOLIA

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ABSTRACT

Curvularia bannonii Morgan-Jones, a new species, causing chlorotic to pale brown lesions on leaves of small-flower morning glory [*Jacquemontia tamnifolia* (L.) Grisenbach] in the southeastern United States, is described and illustrated. It is compared with other species of *Curvularia* Boedijn, particularly *C. eragrostidis* (P. Henn.) Meyer, that have broadly similar conidia.

INTRODUCTION

During the course of conducting a survey of fungal pathogens of troublesome weeds in agricultural row-crop fields in the southeastern United States, a species of *Curvularia* has been encountered on small-flower morning glory and isolated in pure culture. The fungus causes irregularly-shaped, yellowish to brown lesions, or more extensive pale brown areas, on living leaves, and quite severely damages plants, particularly if infected as seedlings. Although similar in morphology to several three-septate species of *Curvularia*, especially *C. clavata* Jain and *C. eragrostidis*, it appears to be undescribed.

TAXONOMIC PART

Curvularia bannonii Morgan-Jones sp. nov. (Plate 1, figure 1).

Maculae amphigenae, irregulares, interdum angulares, persaepe limitatae venis, pallide brunneae. Coloniae dispersae, discretae, interdum effusae, epiphyllae, atro brunneae vel nigrae, pilosae. Coloniae in agaro decocto tuberorum velutinae vel leviter floccosae, griseae vel atrae, post 5 dies 30C ad 83 mm diametro, celeriter crescentes; reverso atro. Mycelium ex hyphis ramosis, septatis, pallide brunneis vel brunneis, levibus vel verruculosis, 2-4 µm crassis compositum. Conidiophora ex apice lateribusque hypharum oriunda, simplicia vel ramosa, flexuosa, interdum geniculata, septata, pallide brunnea vel brunnea, levia, usque at 950 µm longa, 4-7.5 µm crassa. Conidia acropleurogena, recta, elliptica vel obovoidea, levia, 3-septata, brunnea, cellulis extimis pallidioribus, 24-34 µm longa, 13-17 µm crassa.

In foliis vivis Jacquemontiae tamnifoliae, Ruston, Lincoln Parish, Louisiana, U.S.A., June 1986, J.S. Bannon, AUA, holotypus.

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Colonies on potato dextrose agar [Difco], grown at 25C, velvety or somewhat floccose, at first dove gray, becoming charcoal gray to carbonaceous black with age and abundant conidial production, attaining a diameter of 78 mm after 5 days. Colonies on PDA at 20C slower-growing, similar in appearance but having, at first, a distinct, floccose, 7 mm wide, whitish margin (Plate 1, A), attaining a diameter of 48 mm after 5 days. Colonies on PDA at 30C and 35C much faster growing, attaining a diameter of 83 mm and 85 mm, respectively, after 5 days; those at 35C at first somewhat lighter in color with a paler margin (Plate 1, C). Colonies grown at 40C 16 mm in diameter after 5 days. Reverse of all colonies dark gray to black. Mycelium composed of branched, septate, pale brown to brown, smooth or verruculose, 2-4 µm wide hyphae. Conidiophores arising singly, terminally or laterally on the hyphae, simple or loosely branched, flexuous, often somewhat geniculate, sometimes slightly nodose, septate, pale brown to brown, generally slightly paler towards the apex, smooth-walled, up to 950 µm long, 4-7.5 µm wide. Conidiogenous cells terminal, later sometimes becoming intercalary, cylindrical or slightly inflated at fertile loci, integrated, mono or polyblastic, sympodial, cicatrized. Conidia acropleurogenous, straight, very rarely slightly curved, ellipsoidal or obovoid, or sometimes slightly pyriform, when immature usually somewhat clavate, smooth, 3-septate, with the median septum usually, but not always, more or less truly median, where not with the upper of the two central cells slightly larger, brown, end cells appreciably paler, 24-34 µm long, 13-17 µm wide, with a nonprotuberant basal scar.

On leaves of *Jacquemontia tamnifolia* (L.) Grisenbach; North America.

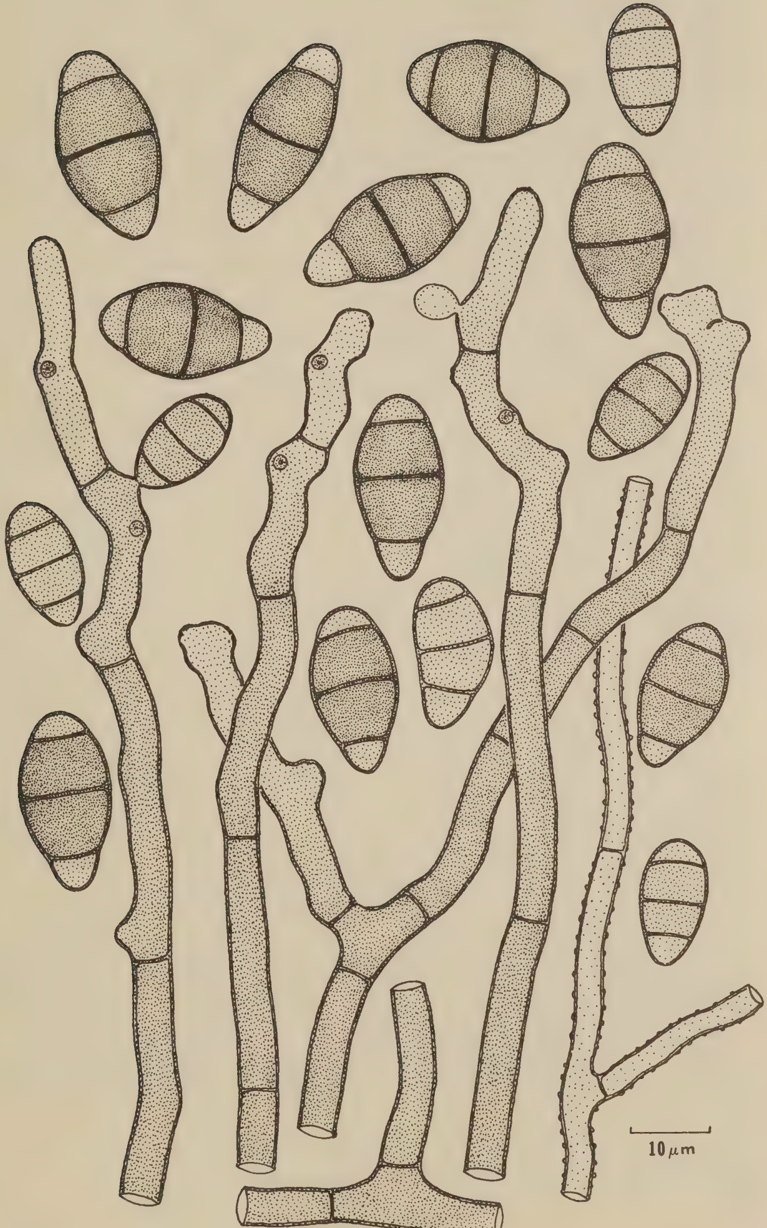
Collection examined: on living leaves of *J. tamnifolia*, Ruston, Lincoln Parish, Louisiana, U.S.A., June 1986, J.S. Bannon, AUA, type. Also cultures derived from this collection.

Curvularia bannonii is named for Dr. James S. Bannon, its collector.

DISCUSSION

Because conidial morphology in species of *Curvularia* tends to be somewhat variable, *C. bannonii* is described as a new species advisedly and after some deliberation. This because it bears close similarity to several previously known species. Among these, it resembles *C. eragrostidis* most closely. Following comparison with several isolates of that species that are considered typical [isolated ex *Ananas comosus* (L.) Merr., Zambia, August 14, 1973, B.K. Patel, IMI 1783812, AUA; isolated ex *Zea mays* L., Camp Hill, Tallapoosa Co., Alabama, U.S.A., July 1975, G.W. Karr Jr., AUA; isolated ex soil, Auburn, Lee Co., Alabama, U.S.A., July 1975, G. Morgan-Jones, AUA], I am, however, satisfied that it can be readily distinguished from it by several features of conidial morphology. Although their dimensions overlap, the length / width ratios of the conidia of the two species are different, those of *C. bannonii* being consistently longer in relation to their width than those of *C. eragrostidis*. Additionally, no conidia of *C. bannonii* have been encountered that reach the width [20 um (personal observation and Ellis, 1966)] sometimes attained in *C. eragrostidis*. The conidia of *C. eragrostidis* are, moreover, typically barrel-shaped with both apical and basal cells broadly rounded. The conidia of

FIGURE 1. *Curvularia bannonii*; conidiophores and conidia.


10 µm

C. bannonii are predominantly obovoid and the end cells are somewhat conical in shape. In the latter respect, *C. bannonii* conidia resemble those of *C. intermedia* Boedijn, another three-septate species in which the median septum is truly median. That taxon, however, has curved conidia. The basal cells have the aspect of those of *C. richardiae* Alcorn. An added distinction between *C. bannonii* and *C. eragrostidis* lies in the thickness of the median septum. In the latter, the median septum is very dark and considerably thickened (Plate 2, G & H), sometimes appearing as a broad black band. In *C. bannonii*, although in older conidia the central septum is slightly thicker than those on either side, it does not become thickened to the degree typical of *C. eragrostidis*. *Curvularia bannonii* conidia somewhat resemble in general shape those of *C. clavata*, particularly when immature, but are easily distinguishable from them in several respects. As is the case in *C. richardiae*, the apical cell of the conidium of *C. clavata* is broadly rounded and follows the curvature of the third cell from the base, which is invariably larger than the others, and is concolorous with it. The position of the median conidial septum in *C. bannonii* vis-ā-vis the apex and base is somewhat variable. In many conidia it approximates being truly median, in others it is slightly off-center, usually resulting in one of the central cells being larger than the other.

Among other three-septate species of *Curvularia*, *C. bannonii* also resembles *C. brachyspora* Boedijn and *C. ovoidea* (Hiroe & Watan.) Muntañola but differs from both in having generally longer conidia. *Curvularia brachyspora* is similar in having conidia with usually a truly median septum that traverses the conidium at its widest point and is often slightly thicker than the other septa The conidia of *C. brachyspora* are, however, usually slightly curved and always unequal-sided. *Curvularia ovoidea* differs in having conidia in which the second cell from the apex is appreciably larger than the others because the middle septum is closer to the base than to the apex. In that species also a sizable proportion of the conidia are asymmetrical.

Matsushima (1975) described and illustrated three fungal isolates identified as *C. eragrostidis* from soil in Kagoshima and Okinawa Prefectures, Japan. Judging from his descriptions and illustrations, none of these, although they possess a thick dark median septum, are typical of the species unless it is highly variable. One, isolated from forest soil, Iremoto Island, Okinawa (Matsushima 4399) has a striking resemblance to *C. bannonii*, although its conidial shape is slightly different. Another, isolated from garden soil, Yaku Island, Kagoshima (Matsushima 4135) has asymmetrical conidia. In addition, Matsushima reported four other *Curvularia* isolates to which he could not, with confidence, apply a specific epithet. Although much narrower and having mostly unequally-sized central cells, their three-septate, predominantly straight conidia have a similar appearance to those to which he applied the binomial *C. eragrostidis*. It seems possible that one or more taxa with straight, more or less symmetrical, three-septate conidia remain to be recognized within the genus *Curvularia*.

Curvularia bannonii is a thermotolerant fungus which will grow at temperatures of up to 40C. Although it has only been collected on *J. tamnifolia*, there is some evidence that it is not host-specific. Host range studies (Bannon, unpublished data) have indicated *Zea mays* to also be susceptible to infection by *C. bannonii*. Moreover, there are varietal differences within that host, sweet corn being the most susceptible.

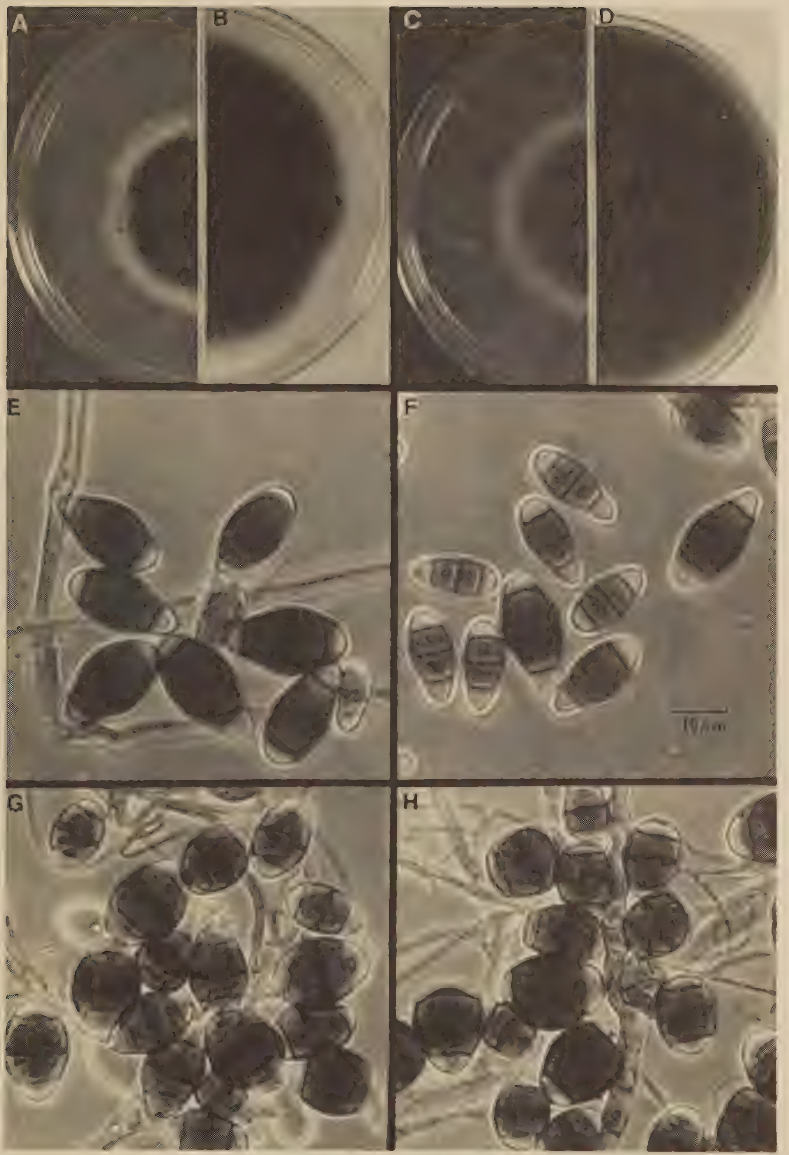


PLATE 1. *Curvularia bannonii* A, 5-day-old colony on PDA at 20C; B, same at 25C; C, 3-day-old colony at 35C; D, 5-day-old colony at 35C; E, conidiophore and conidia; F, immature and mature conidia; G & H, *Curvularia eragrostidis* (Alabama corn isolate) conidiophore and conidia.

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HYPOXYLON OCEANICUM SP. NOV. FROM MANGROVES

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There have been several recent taxonomic and ecophysiologic papers on higher marine fungi from mangrove habitats (Hyde and Jones, 1988; Hyde, 1986; Kohlmeyer, 1986; Kohlmeyer and Volkmann-Kohlmeyer, 1987; Findley et al. 1986; Schatz, 1985). Mangrove forests are an important component of near-shore tropical ecosystems and marine fungi play a role in both the food web as an energy source for invertebrates (Kohlmeyer and Bebout, 1986) and in nutrient regeneration cycles as decomposers of dead and dying organic matter (Fell & Master, 1980; Fell & Newell, 1981). I have collected several higher marine fungi in mangrove habitats and one of these, a species of *Hypoxylon*, is described as new.

Hypoxylon *oceanicum* sp. nov. Fig. 1 A-C.

DESCRIPTION

Stromatibus 1.0-2.0 mm diam, subglobosis, solitariis vel caespitosis, bistratis; strato externo carbonaceos pigmentosos 170-300 um crasso, strato intimo nonpigmentosos 150-250 um crasso; ascomatibus subglobosis, 320-360 um altis, 425-475 um diam, ostiolatis, breve papillatis; paraphysibus persistens, 2-2.5 um diam; ascis octosporis, cylindricis, unitunicatis, stipitatis, annulo apicali in liquore iodata Melzeri immerso cyanescente, 115-185 um longitudine tota x 12.5-22.5 um; ascosporis brunneis, unicellularis, 18.75-25 x 7.5-11.25 um subglobosis ad late ellipticus cum extremitatibus rotundatis, rimam germinativem rectam praeditis, monostichis in ascis imbricatis.

Stromata 1.0-2.0 mm diam, subglobose, solitary or caespitose, of two layers - outer layer carbonaceous, pigmented 170 - 300 um thick, inner layer non-pigmented, 150-250 um thick; Ascomata 320-360 um high, 425-475 um diam, subglobose, ostiolate, short papillate; Paraphyses persistent, broad, 2-2.5 um diam; Asci eight-spored, cylindric, stipitate, with the apical ring bluing in Melzers reagent, 115 -185 um total length X 12.5 -22.5 um ; Ascospores brown, one-celled, 18.75 - 25 um X 7.5 - 11.25 um, subglobose to broadly eliptic, rounded ends, with a straight germ slit, monostichously arranged in the ascus. Substrate: on littoral parts of Rhizophora spp. and Tamarix gallica growing among barnacles and macroscopic algae. Range: Atlantic Ocean, Caribbean Sea and Pacific Ocean. Named in recognition of its being closely associated with marine environments.

Material examined:

Hypoxylon oceanicum
Host: Rhizophora mangle: FLA-16, J.B. Lloyd State Park, Dania, coll. 25.IV.86 (HOLOTYPE); FLA-67, J.B. Lloyd State Park, Dania, coll. 10.XI.86; JK 1730 Bonita Springs, FL 10.I.64; JK 1735 Punta Garda, FL 10.I.64; JK 1755 Virginia Key, FL 10.I.64; JK 1766 31.III.63 Brazil; JK 4010 29.I.76 Trinidad
Host: Rhizophora spp. JK 4646 I.XI.84 Tobago; JK 4810 20.XI.84, 29.XI.85 Belize
Host: Tamarix gallica JK 3724 13.V.76 Bermuda

Hypoxylon quisquiliarum
Hosts Unknown: Cayenne: (TYPE) 366 Leprieur, Cayenne, Herb. Berk. 1879 {KEW}
Florida: Matheson Hammock, Dade Co., coll. Shear, det. J.H. Miller {BPI} Brazil: 20554 & 20567 Rio Grande do Sul, {BPI}
China: (Yunnan) 376 Y. Tsiang, 15.12.33; (Hainan) 6834 S.Q. Deng 11.23.34 {BPI}.

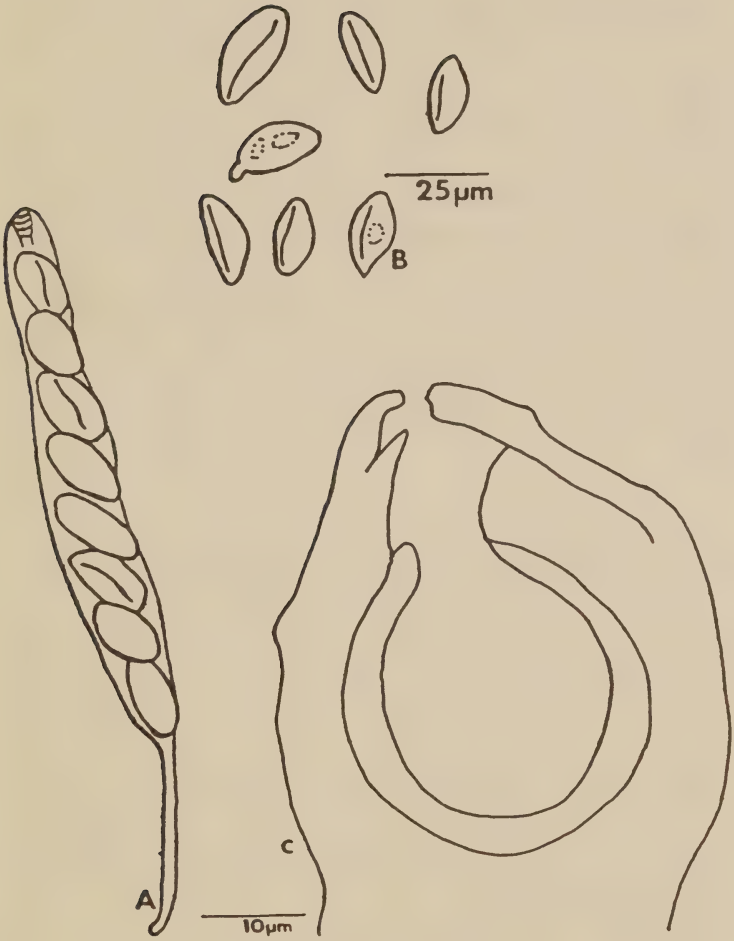
25µm
B
A
C
10µm

Fig. 1. *Hypoxylon oceanicum*: A. Ascus. B. Ascospores (Holotype). C. Ascoma (JK 1735).

DISCUSSION

Hypoxylon oceanicum can be assigned to the Section Papillata subsection Primo-Cinerea of Miller (1961) and seems closely related to *Hypoxylon quisquiliarum*. In gross morphology they are quite comparable with a carbanous, subglobose, two-layered stroma with papillate ascomata. However, there exist significant differences in ascospore dimensions, aspects of ascospore shape and in the type of germ slit on the ascospores of the two species. The dimensions of the ascospores of *Hypoxylon quisquiliarum* and *H. oceanicum* slightly overlap (Table 1) but statistical analysis showed the dimensions to be significantly different ($P < .05$). In *Hypoxylon oceanicum* the ascospore ends are rounded. In *H. quisquiliarum* the ends are pointed. The germ slit in *H. quisquiliarum* is curved or spiraled while in *H. oceanicum* it is straight and less than the full length of the ascospore. In addition, the ascus length in *H. oceanicum* is shorter than that of *H. quisquiliarum*.

TABLE 1. COMPARISON OF ASCOSPORE DIMENSIONS: *HYPOXYLON OCEANICUM* AND *H. QUISQUILIARUM.*

HYPOXYLON	length (*)	width (*)	range
oceanicum	21.58** (1.64)	9.88**(.65)	18.75-25.0 x 7.50-11.25
quisquiliarum	26.717***(2.92)	12.546***(1.89)	20.00-37.5 x 10.00-17.5

* +/- standard deviation
**mean, n=80
***mean, n=91

Hypoxylon oceanicum is a saprophyte on dead or dying branches of *Rhizophora* spp. and *Tamarix gallica* growing among barnacles and macro-algae. According to Rogers (1979) many xylariaceous fungi are substrate specific at the host genus or host family level.

Hypoxylon oceanicum is not host specific at either the genus or family level. Geographically, *H. oceanicum* displays a broad distribution spanning the Pacific Ocean, the Caribbean Sea and the Atlantic Ocean and appears physiologically well adapted to the rigors of a saline environment.

Several species of *Hypoxylon* are found in both wet tropical and xeric environments (Rogers, 1979). The stroma probably conveys a distinct advantage in an atmosphere of high heat and solar radiation and to surviving prolonged periods of desiccation. *H. oceanicum* occurs primarily in the upper littoral zone where it is subject to regular periods of immersion in seawater, prolonged exposure to salt spray and exposure to high ambient temperatures, desiccation and high solar radiation. The littoral occurrence among barnacles and macro-algae suggests that *H. oceanicum* is an obligate marine fungus. *Hypoxylon oceanicum* can be included in the group of secondary marine fungi (Kohlmeyer and Kohlmeyer, 1979). The thick stroma and well developed apical apparatus in the ascus is typical of this group. Several mangrove fungi display similar adaptations to the extremes of the mangrove environment including, *Aigialus grandis* Kohlmeyer and Schatz, *Aigialus parvus* Schatz and Kohlmeyer, *Lophiostoma mangrovis* Kohlmeyer and Vittal and *Caryosporella rhizophorae* Kohlmeyer. *Adomia avicenniae* Schatz which has been collected in Australia and the Red Sea region and *Lophiostoma lignatilis* from the Caribbean region possess immersed ascomata surrounded by a thickened clypeus in the latter, and thickened, pigmented incrustations around the neck in the former (Kohlmeyer and Vittal, 1986). While acting as a protective mechanism from climatic conditions the thick peridium does not present a physical or chemical barrier to invertebrate grazers (J. Kohlmeyer - personal communication).

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A NEW SPECIES OF CYATHUS FROM MEXICO

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ABSTRACT

Cyathus morelensis sp. nov. (Nidulariaceae) is a large species distinguished by clear striation of exoperidium and endoperidium, two layered cortex of peridioles, and spores hyaline ovate. This species is closely related taxonomically to C. limbatus Tul.

INTRODUCTION

Few studies have been done on the Nidulariales of Mexico (Herrera, 1961, 1964; Brodie, 1971, 1975) but many specimens have been collected and some of them are being named on mycofloristic works (Pérez-Silva et al., 1987). Descriptions and detailed analysis of some specimens kept on several Mexican herbaria MEXU, ENCB, FCME and IZTA (León-G. and Pérez-Silva, 1988) are made for several species that have not been named before.

The material herein described is found in MEXU Herbarium, and has enough characteristics to consider it as a new species.

TAXONOMY

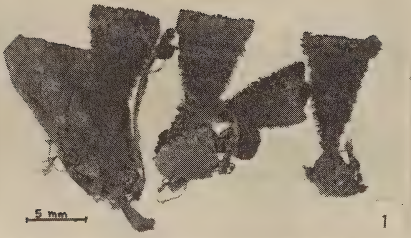
Cyathus morelensis sp. nov.

Figs. 1-7

Peridium infundibuliforme, atrobrunneum, 8-9 mm altum, ad orem 6-7 mm diametro, disco basali concoloro parvo; exoperidium strigosum, prope marginem leviter striatum, margine leviter fimbriato; endoperidium striatum, atrogriseo-argenteum. Peridiola 2.2 X 3.2 mm, conspicue ellipsoidea; nigra, tunica tenui, cortice tenui bistrato, funiculo gracili. Sporae hyalinis sparsis, 15-22 um longae, 9-14 µm latae, ovoideae vel guttuliformes, conspicue apiculata, pariete tenui 1 µm.

HABITAT: In sylvis montium ad solo vel in foliis siccis caducis. Km. 6, road. Cuernavaca-Tepoztlán, Morelos; E. Pérez-Silva, 12 Sept. 1970.

HOLOTYPUS: MEXU-7687. Herbario Nacional, Instituto de Biología, U.N.A.M., México.



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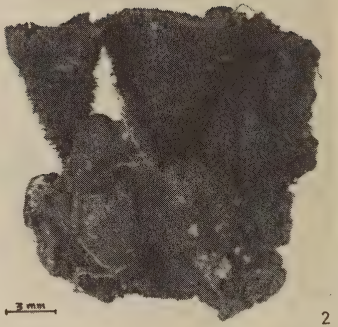

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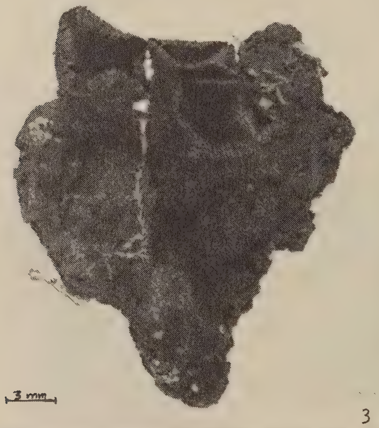

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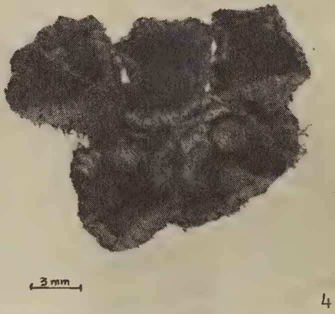

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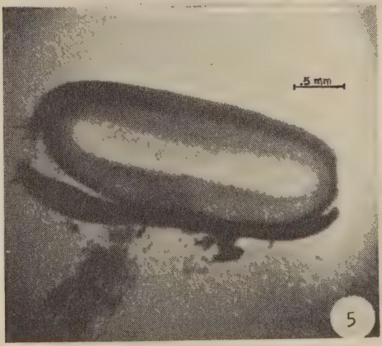

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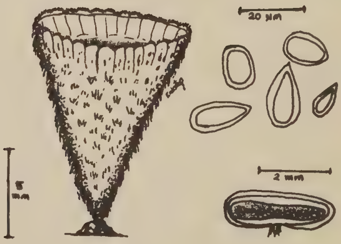

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Figs. 1-6. Cyathus morelensis. 1. Group of basidiocarps showing fimbriate margin. 2. Basidiocarp in soil. 3, 4. Upper part of basidiocarps showing peridioles and the striation of the endoperidium. 5. Transverse section of peridiole showing double cortex and part of funiculus. 6. Drawing showing the infundibuliform aspect of the basidiocarp, the form of the spores and the transverse section of one peridiole with 2 layers.

Cyathus morelensis sp. nov.

Cups infundibuliform 8-9 mm high X 6-7 mm wide at mouth; basal emplacemnt small, concolore. Exoperidium strigose with margin striate and finaly fimbriate. Endoperidium striate, gray-silvery coloured. Peridioles about 2.2 X 3.2 mm, ellipsoidal, with thin tunica. Peridioles with two layered cortex. Funiculus thin. Spores hyaline, 15-22 X 9-14 µm, ovate, gutuliform, with epispore thin less than 1 µm thick.

HABITAT: Temperate country, on soil and litter. Km. 6 road Cuernavaca-Tepoztlán, Morelos. E. Pérez-Silva, 12 Sept. 1970.

HOLOTYPE: MEXU 7687, National Herbarium. Biology Institute, UNAM, Mexico.

The specific name *morelensis* refers to the state Morelos, Mex., location where this species was collected.

DISCUSSION

C. morelensis is related with the species *C. olivaceo-brunneus*, *C. poeppigii* and *C. limbatus* by clear striation of exoperidium and endoperidium, two layered cortex of peridioles; moreover *C. poeppigii* and *C. olivaceo-brunneus* have ellipsoidal spores. *C. limbatus* have basidiocarps wider at the mouth and ovoid spores; all these characters except the morphology of peridioles are lacking in *C. morelensis*. All these species, including the new one, develop on soil and litter.

AKNOWLEDGEMENTS

We wish to thank Dr. T. Herrera from Instituto de Biología, UNAM, México and Dr. J.H. Brodie from Univ. Victoria Canada that have kindly suggested improvements in the paper, and to Dr. F. Chiang from Instituto de Biología, UNAM for his help in the latin diagnosis.

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A NEW SPECIES OF MELODERMA (RHYTISMATACEAE), WITH NOTES ON MELODERMA AND RELATED GENERA

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SUMMARY

Meloderma dracophylli sp. nov., found on several *Dracophyllum* species (Epacridaceae), is described and illustrated. Development of the sterile ascocarp tissues in *Meloderma* species is compared with that in other Rhytismataceae. Two kinds of development, which correlate with macroscopic ascocarp appearance, are recognised in *Meloderma*. One, from the species on *Pinus*, is similar to ascocarp development in some *Lophodermium* species on *Pinus*; the second, from the species on Epacridaceae, is similar to ascocarp development in some *Lophodermium* and *Lophomerum* species on Ericaceae and Pyrolaceae. Ascospore shape, although convenient to use as a generic character, cannot be used to determine 'natural' relationships in the Rhytismataceae.

INTRODUCTION

The genus *Meloderma* was erected by Darker (1967) to accommodate the *Pinus*-inhabiting *Hypoderma desmazieresii* Duby. Darker thought this species more closely resembled *Lophodermium pinastri* (Schrader) Chevallier than it did other *Hypoderma* species, and in support of this cited similarities in ascus shape, and in the position of the developing ascocarp in relation to host tissue. The short, cylindric spores of *H. desmazieresii* excluded it from the filiform-spored *Lophodermium.*

Since 1967 two species have been added, *Meloderma sharmarum* Cannon & Minter, also occuring on *Pinus*, and *M. richeae* (Petrak) Parbery & Minter, found on *Richea* (Epacridaceae). Parbery & Minter (in Minter & Hettige 1983) stated that they placed this species in *Meloderma* "without great confidence", but did so because it appeared to have a combination of characters more or less intermediate between *Lophodermium* and *Hypoderma*. Another species, similar to *M. richeae*, is found in New Zealand on *Dracophyllum* (Epacridaceae), and is described in this paper as *Meloderma dracophylli.*

Ascocarp development, and the morphology associated with ascocarp opening, are considered to be important indicators of relationships amongst the Rhytismataceae (Johnston 1988). The present paper describes the development of sterile ascocarp tissues in the species placed in *Meloderma*, and uses this as evidence to suggest relationships between these species and others from the genera *Lophodermium* and *Lophomerum*. Ascocarps, taken from herbarium material, were rehydrated in 3% KOH, sectioned at 10 μm using a freezing microtome, and mounted in lactophenol. Asci, ascospores, and paraphyses were examined from squash mounts made in 3% KOH and Melzer's solution. Cultural characteristics were determined from single ascospore isolates grown on Difco oatmeal agar. Colonies were incubated at 20°C under near ultraviolet and cool white fluorescent light, with a cycle of 12 hour light/12 hour dark.

DESCRIPTION OF NEW SPECIES

Meloderma dracophylli sp. nov. (Figs 1, 2, 10)

Ab *M. richea* ascis 8-sporis, ascosporae 19-25 x 3.5-4 μm differens.

HOLOTYPE: GISBORNE, Urewera National Park, near Lake Waikaremoana, Puniho Swamp, on *Dracophyllum longifolium* (J.R. & G. Forst.) R. Br., coll. Johnston (R286), 29 May 1983 (PDD 44481).

ETYMOLOGY: *dracophylli*; refers to host substrate.

Ascocarps and pycnidia developing in pale areas of fallen leaves, often surrounded by narrow, black zone lines. Ascocarps 0.5-0.8 x 0.4-0.5 mm, broad-elliptic to more or less circular in outline. Immature, unopened ascocarps with uniformly

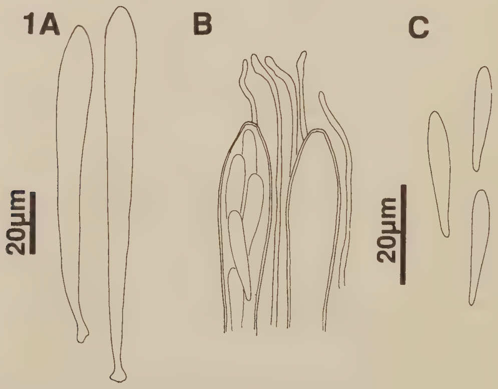


Fig 1 *Meloderma dracophylli*. **A.** Asci. **B.** Detail of ascus and paraphyses apex. **C.** Released ascospores.

black walls. When mature, walls oriented at a steep angle to surrounding host tissue, black, with a flattened, pale area around the single opening slit. Opening not extending to ends of ascocarp, and often with the two sides of the opening slit pulling apart so exposing the hymenium even when ascocarp dry. Pycnidia 0.2 mm, circular in outline, brown-walled, pustulate.

Ascocarps subcuticular. In vertical section upper wall up to 100 μm wide near ascocarp opening, narrower toward outer edge. Upper wall comprising 2 layers, an outer layer of dark brown, thick-walled, angular cells, and an inner layer of hyaline, thin-walled, downward-projecting, cylindric cells. The cells in part of the inner layer near the ascocarp opening becoming dark brown and thick-walled as the ascocarp matures. Exposed face of broken upper wall lined with layer of short-cylindric, hyaline to pale brown cells. Lower wall 10-15 μm wide, of 2-3 layers of brown to dark brown, thick-walled cells.

Paraphyses 1.5-2 m diam., often circinate near apex, extending 10-15 μm beyond asci. Asci 95-125 x 9-12.5 μm, clavate, tapering gradually to base, and tapering to small, truncate apex, 8-spored. Ascospores 19-25 x 3.5-4 μm, narrowly obovoid, tapering toward base, ends rounded, 0 septate, surrounded by a well-developed gelatinous sheath.

Pycnidia in vertical section subcuticular, upper wall 5 μm wide, comprising very dark tissue with no obvious cellular structure. Lower wall 10-15 μm wide, comprising dark brown, thick-walled, angular cells lined with conidiogenous layer. Conidiogenous cells 15-22 x 2-3 μm, tapering to apex, solitary, with sympodial proliferation, often with 2 conidia held at apex. Conidia 3.5-5 x 1-1.5 μm, cylindric with rounded ends, 0 septate. Amongst conidiogenous cells are filiform sterile elements up to 45 μm long.

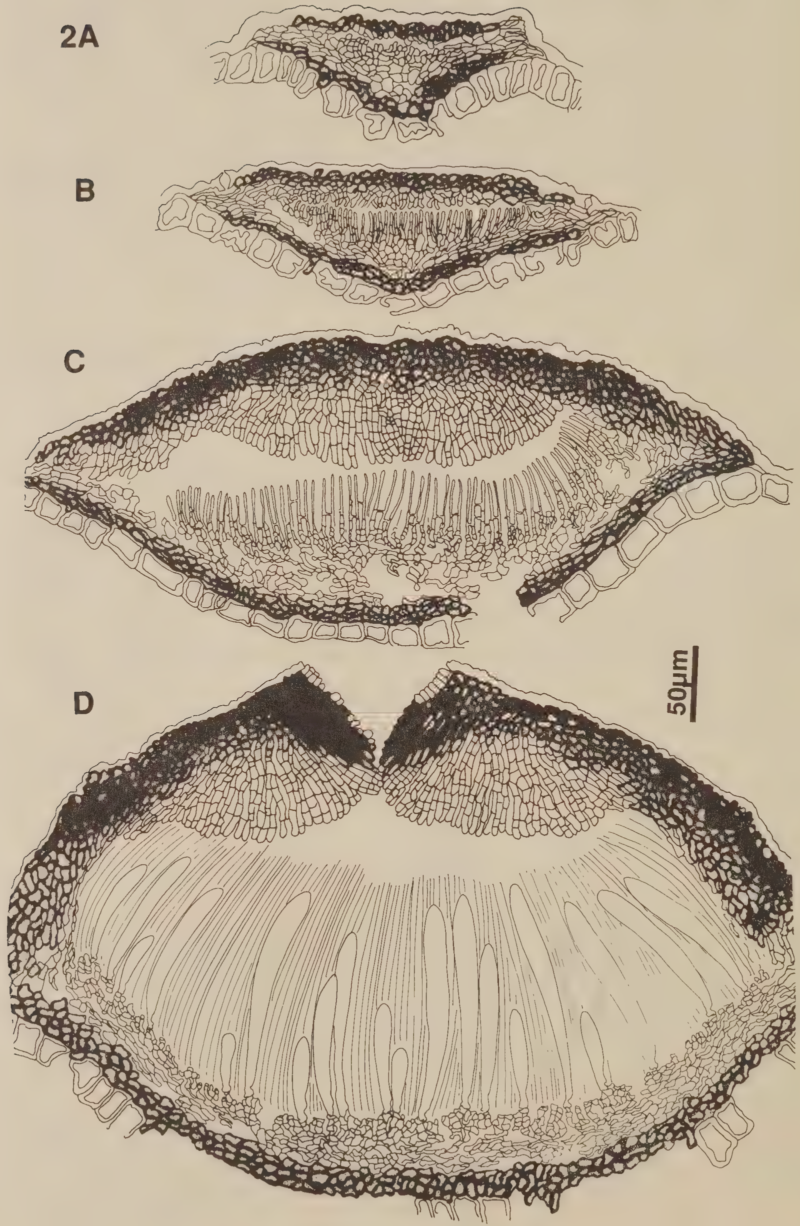
CHARACTERISTICS IN CULTURE: Ascospores germinating on agar plates within 48 hours. On oatmeal agar colonies 4.5 cm diam. after 6 weeks; aerial mycelium low, sparse, cottony, white; agar surface with pinkish, vinaceous, or yellowish colours toward centre of colony. Black-walled, globose pycnidia on agar surface, opening by an irregular slit to expose conidial ooze, conidiogenous cells and conidia as described *in vivo*.

HABITAT: On dead, fallen leaves of *Dracophyllum longifolium, D. uniflorum* Hook.f., *D. subulatum* Hook.f.

DISTRIBUTION: New Zealand: Taupo, Gisborne, Taranaki, Buller, North Canterbury, Mid Canterbury.

ADDITIONAL SPECIMENS EXAMINED: 12 collections were examined, including, Taranaki, Mt. Taranaki, Enchanted Trail Tr., on *Dracophylum longifolium*, coll. Johnston (R239), Samuels & Petersen, 24 Mar 1983 (PDD 45037). Taupo, Tongariro National Park, vic. Mangatepopo Hut, on *Dracophyllum longifolium*, coll. Johnston (R422) & McKenzie, 25 Mar 1984 (PDD 45303). Mid Canterbury, Arthur's Pass, Cass, on *Dracophyllum uniflorum*, coll. Johnston (R785), 22 Feb 1988 (PDD 48511).

NOTES: *M. dracophylli* is macroscopically indistinguishable from the Australian species *M. richeae*. However, *M. richeae* has shorter, 4-spored asci, and larger, often 1-septate ascospores.


2A
B
C
D
50µm

PATTERNS OF ASCOCARP DEVELOPMENT

Species examined:

- *Meloderma desmazieresii* - England, Kent, Bedgebury Pinetum, on *Pinus strobus*, coll. Minter, 17 Oct 1982 (IMI 304126). Canada, Ontario, L. Imagami, Bear Is., on *Pinus strobus*, coll. Darker, 6 Sep 1923 (PDD 25636, ex DAOM 109242).
- *Meloderma dracophylli* - see above for details of collections examined.
- *Meloderma richeae* - Australia, Mt Baw Baw, on *Richea continentis*, coll. Beaton, Jan 1967 (IMI 129993); Mt Baw Baw, on *Richea continentis*, coll. Fuhrer, 30 Dec 1966 (IMI 126084).
- *Meloderma sharmarum* - Bhutan, Thumphu, Dugel Dzong, on *Pinus* sp., coll. Sharma, 9 Aug 1981 (IMI 184396).
- *Lophodermium conigenum* (Brunaud) Hilitzer - New Zealand, Nelson, Abel Tasman National Park, Coastal Walk, on *Pinus radiata*, coll. Johnston, Samuels, Beever & Petersen, 19 Apr 1983 (PDD 43768).
- *Lophodermium pinastri* - Scotland, vic. Ullapool, Lael Forest Reserve, on *Pinus contorta*, coll. Johnston & Gibellini, 8 Jun 1986 (PDD 48175).
- *Lophodermium pyrolae* Parmelee - Canada, British Columbia, Vancouver Is., Cameron, on *Pyrola bracteata*, coll. Ziller (BPI - isotype ex DAOM 55041).
- *Lophodermium sphaerioides* (Albertini & Schweinitz) Rehm - Canada, Manitoba, Barrens R., on *Ledum groenlandicum*, coll. Bisby, 31 Jul 1935 (IMI 23119c).
- *Lophomerum rhododendri* (Cesati) Remler - Switzerland, Kt. Graubnden, Engadin, Zuoz, Wald im Vel Arpiglia, on *Rhododendron ferrugineum*, coll. Müller, 25 Jul 1973 (ZT).

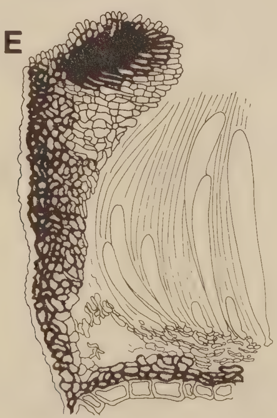


Fig 2 *Meloderma dracophylli* (PDD 45303), ascocarps in vertical section. **A.** Immature ascocarp prior to development of paraphyses. **B, C.** Unopened ascocarps showing internal differentiation of upper wall. **D.** Upper wall of ascocarp starting to break open. **E.** One side of fully opened ascocarp.

Two patterns of development of sterile ascocarp tissues were seen in the species considered in this paper.

1. Meloderma richeae, M. dracophylli, and Lophodermium sphaerioides.

All three species show essentially the same pattern of ascocarp development, with only minor differences in overall size and extent of the various layers present. The group is characterised by a two-layered ascocarp upper wall, with an extensive inner layer of downward-projecting, cylindric, hyaline cells. *Lophomerum rhododendri* and *Lophodermium pyrolae* have the same ascocarp upper wall structure, but as only a single ascocarp was sectioned for each of these two species, the developmental sequence could not be compared.

The ascocarp develops between the host cuticle and epidermis. The ascocarp initial comprises hyaline plectenchyma, and is more or less lens- shaped in vertical section. At both the top and bottom of this structure the outermost cells soon become dark brown and thick-walled, thus starting to form the upper and lower wall layers of the ascocarp. At about the stage that wall layers are starting to differentiate, a cavity develops in the central part of the plectenchyma, and paraphyses grow upward from the thin-walled, more or less globose cells which line

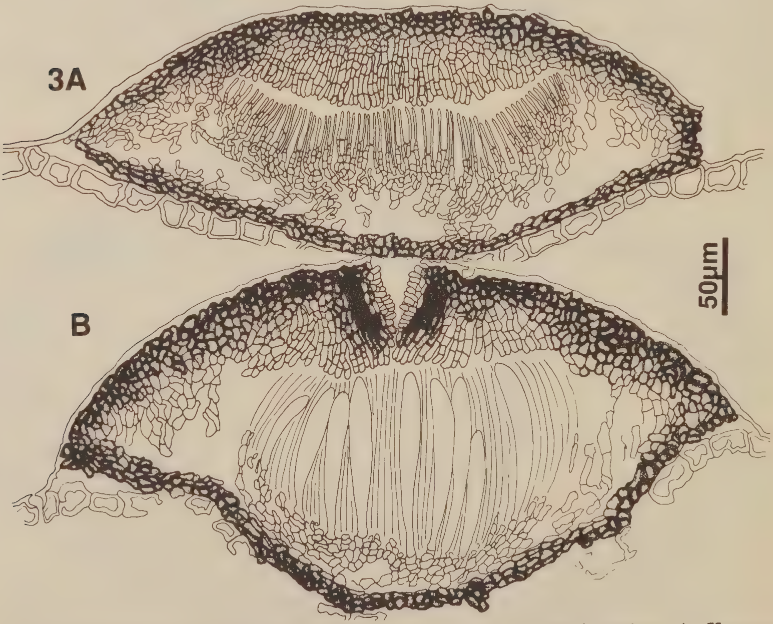


Fig 3 *Meloderma richeae* (IMI 129993), ascocarps in vertical section. **A.** Unopened ascocarp. **B.** Upper wall of ascocarp starting to break open.

the base of this cavity (Fig 2A). Anastomoses form near the bases of adjacent paraphyses. The part of the upper wall above the developing hymenium, in the central part of the ascocarp, starts to become wider and internally differentiated (Fig 2B). The outer 3-4 layers of cells are angular, dark brown, and thick-walled, while the inner layer comprises thin-walled, hyaline, downward projecting, cylindric cells (Fig 2B, 2C, 3A, 4A). The downward projecting cells of the upper wall, and the upward projecting paraphyses of the developing hymenium almost meet. As the ascocarp matures the paraphyses become longer, ascus initials develop, and the upper wall in the central part of the ascocarp becomes up to 100 μm wide, with most of the wall now comprising downward projecting rows of hyaline, cylindric, cells. The cells of this layer immediately to either side of the centre become dark brown and thick-walled (Fig 4B, 5). The ascocarp opens when the upper wall breaks along the line of hyaline cells remaining at the centre of the ascocarp (Fig 2D, 3B). The group of cells on either side of the break continues to darken, becoming very dark, often with the cellular structure obscured in opened ascocarps (Fig 2D). After the ascocarp opens hyaline, cylindric cells develop along the exposed face of the broken upper wall (Fig 2D, 2E, 3B, 4C). The lower ascocarp wall remains virtually unchanged during ascocarp maturation, at all stages comprising 2-4 rows of brown to dark brown, slightly thick-walled cells.

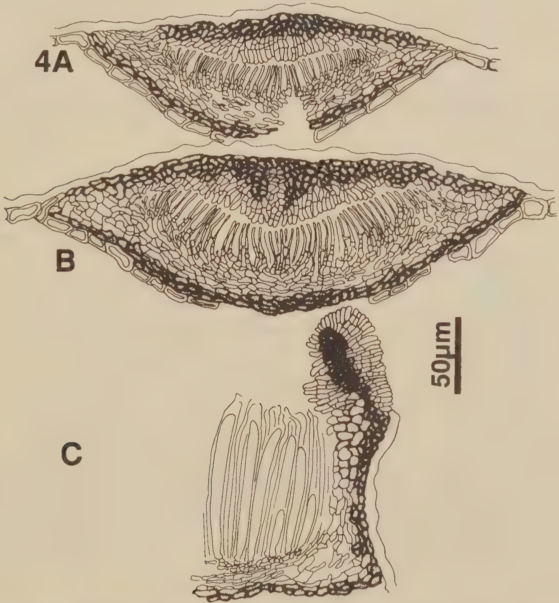


Fig 4 *Lophodermium sphaerioides* (IMI 23119c), ascocarps in vertical section. **A.** Unopened ascocarp showing internal differentiation of upper wall. **B.** Unopened ascocarp showing darkened cells immediately to either side of future line of ascocarp opening. **C.** One side of fully opened ascocarp.

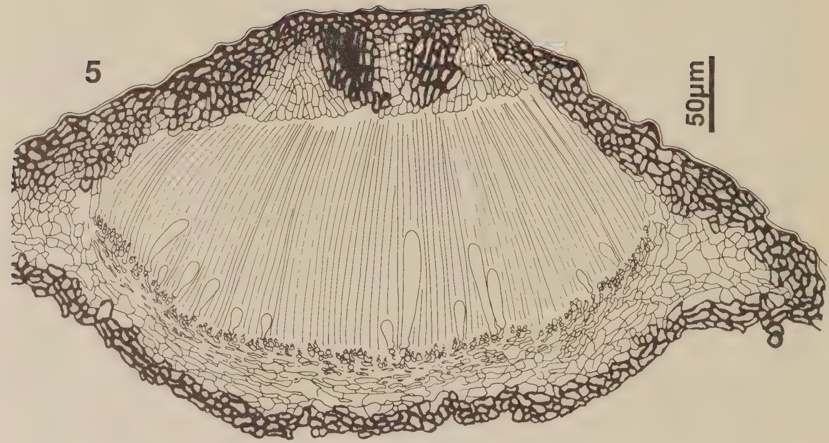


Fig 5 *Lophomerum rhododendri* (ZT), ascocarps in vertical section. Unopened ascocarp showing internal differentiation of upper wall, and the darkened cells immediately to either side of future line of opening.

2. Meloderma sharmarum, M. desmazieresii, Lophodermium conigenum, and L. pinastri.

All four species show the same pattern of ascocarp development with only minor differences in the overall extent of the various wall layers present. This group of species is characterised by the nature of the row of thin-walled, hyaline cells that extends along the future line of opening of the ascocarp upper wall. This row of cells, initially found on the inside of the upper wall, becomes completely surrounded by the otherwise dark wall tissue as the ascocarp develops. This kind of ascocarp upper wall structure has previously been illustrated for *L. pinastri* (Jones 1935, fig 19), *L. conigenum* (Hilitzer 1929, fig 18; Minter 1981, fig 8), and *L. seditiosum* (Minter 1981, fig 11).

The ascocarp begins developing between the host cuticle and epidermis, and the central part of the ascocarp remains subcuticular throughout subsequent stages of its development. With increasing radial expansion of the ascocarp, tissues on either side of this central region develop beneath the host epidermal cells. The ascocarp initial comprises hyaline plectenchyma, but at an early stage of development the upper part of this plectenchyma differentiates into brown, angular cells, which represent the first stage in development of the ascocarp upper wall (Fig 6A). Some time after the upper wall is first differentiated paraphyses develop, and these extend into a cavity that forms in the centre of the plectenchyma (Fig 7A, 8A). Anastomoses form near the bases of adjacent paraphyses, and the paraphyses continue to elongate through subsequent stages of ascocarp development. As the

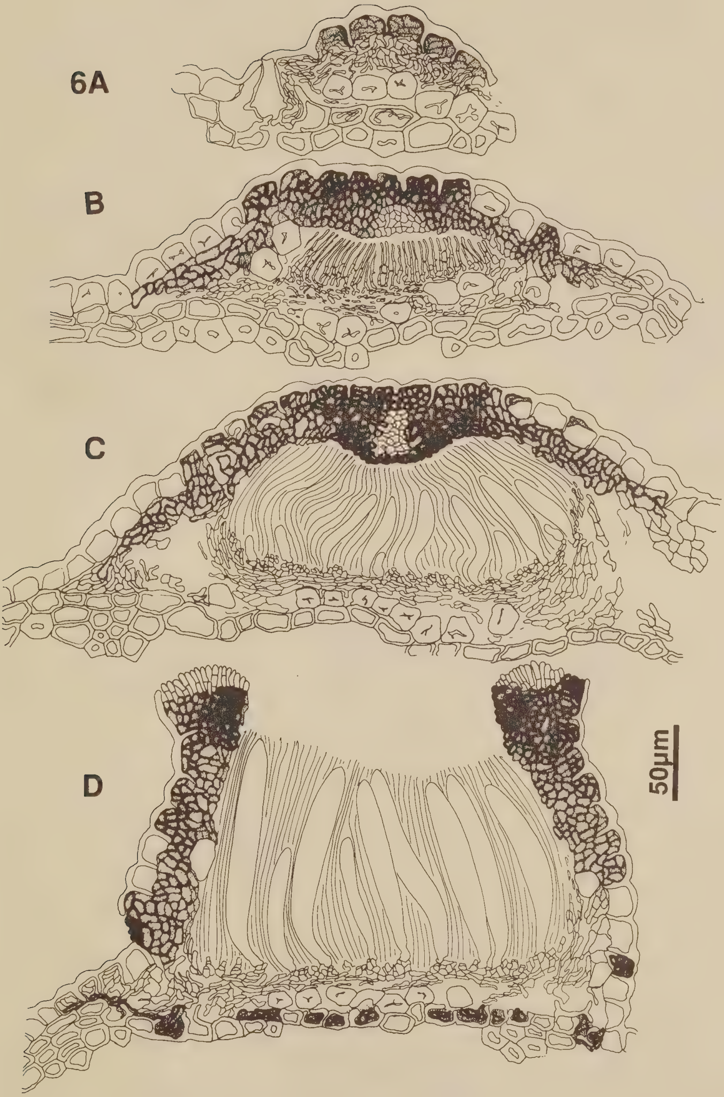


Fig 6 *Lophodermium pinastri* (PDD 48175), ascocarps in vertical section. **A.** Ascocarp prior to development of paraphyses. **B, C.** Different stages in internal differentiation of upper wall. **D.** Fully opened ascocarp.

ascocarp matures the subcuticular part of the upper wall becomes wider, with the inner layers of the wall comprising hyaline, thin-walled angular cells, and the outer layers dark brown, thick-walled, angular cells (Fig 6B, 7A). By the time that developing asci are visible the innermost layer of the upper wall has also become dark-brown, so that a group of hyaline, thin-walled cells is contained within the upper wall near the centre of the ascocarp (Fig 6C, 7B, 8B). The subepidermal part of the upper wall is narrower than the subcuticular part, and comprises paler cells. As the asci mature, a one cell wide, often incomplete layer of darkened cells develops across the lowermost part of the ascocarp. This comprises the lower ascocarp wall, which remains poorly developed through to ascocarp maturity (Fig 6D, 7B, 8B). After differentiated ascospores are visible, the upper wall of the ascocarp breaks open, the break forming through the line of hyaline, thin-walled cells enclosed within the upper wall. A layer of hyaline, thin-walled, cylindric cells develops across the exposed face of the broken upper wall (Fig 6D, 7C).

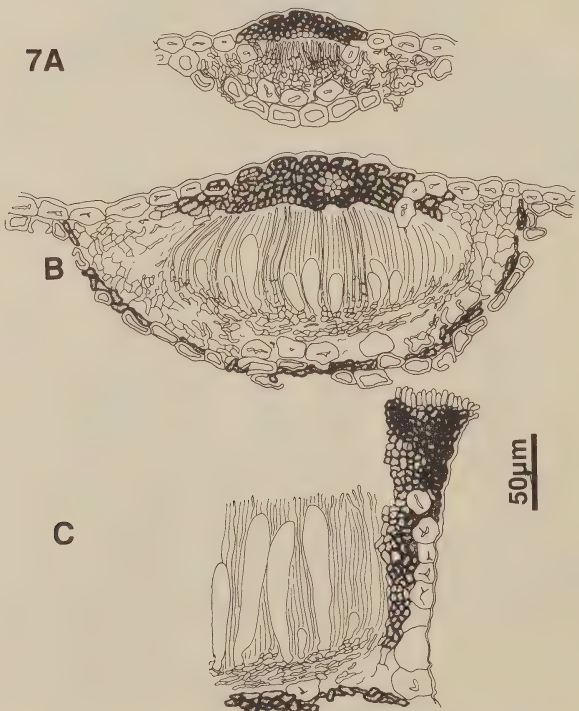


Fig 7 *Meloderma desmazieresii* (IMI 304126), ascocarps in vertical section. **A, B.** Unopened ascocarps showing different stages in internal differentiation of upper wall. **C.** One side of fully opened ascocarp.

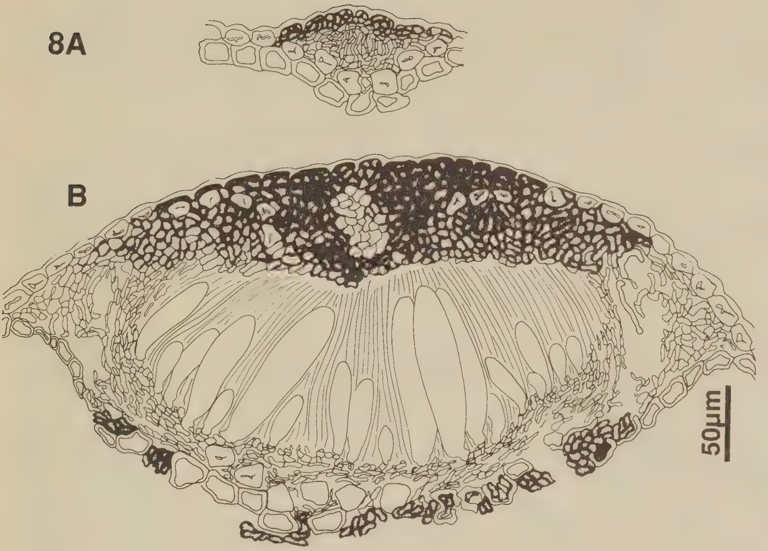


Fig 8 *Meloderma sharmarum* (IMI 284397), ascocarps in vertical section. **A.** Ascocarp prior to development of paraphyses. **B.** Unopened ascocarp showing internal differentiation of upper wall.

MACROSCOPIC APPEARANCE OF ASCOCARPS

Meloderma richeae (Fig 9) and *M. dracophylli* (Fig 10) have ascocarps that are broad-elliptic to more or less orbicular in outline. When mature the walls of dry ascocarps are oriented at a steep angle to the surrounding host tissue. The hymenium often remains partly exposed even when the ascocarp is dry, because the sides of the elongate ascocarp opening do not meet completely, thus leaving an elliptic aperture. The part of the ascocarp adjacent to the opening is flattened, and paler than the otherwise uniformly black ascocarp wall.

Several Rhytismataceae on ericaceous hosts have ascocarps with a similar macroscopic appearance, including *Lophodermium sphaerioides* (Fig 11), *L. pyrolae* (Fig 12), and *Lophomerum rhododendri* (see Minter 1980, fig 1A).

Meloderma desmazieresii (Fig 13) and *M. sharmarum* (see Cannon & Minter 1986, fig 24) have ascocarps that are elliptic in outline, and more or less acute at the ends. When dry the slit-like opening of the ascocarp remains closed, and the walls of the ascocarp barely raise the surface of the host tissue. The ascocarp wall is black toward the centre, paler and greyish toward the edge, but with the very edge of the ascocarp marked by a narrow, black line. The ascocarp opening is lined with a narrow, pale zone.

Many *Lophodermium* species on *Pinus*, such as *L. pinastri* (Fig 14) and *L. conigenum* (Fig 15), have ascocarps similar in macroscopic appearance to *Meloderma sharmarum* and *M. desmazieresii.*

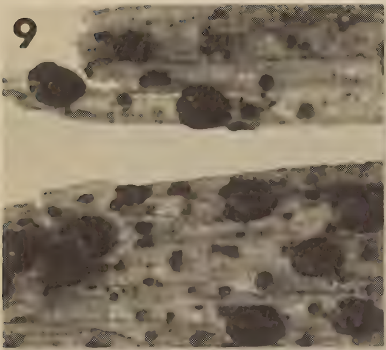
DISCUSSION

The species considered in this paper form two groups, which can be characterised by the internal differentiation in the upper wall of unopened ascocarps. The same two groups can also be defined by host substrate. Species in group 1 (*Meloderma richeae, M. dracophylli, Lophodermium pyrolae, L. sphaerioides* and *Lophomerum rhododendri*) are found on members of the Epacridaceae and the closely related families Ericaceae and Pyrolaceae, while those in group 2 (*Meloderma desmazieresii, M. sharmarum, Lophodermium pinastri*, and *L. conigenum*) are found on Pinaceae. Terrier (1942, plate 10, fig 2; plate 12, fig 2) illustrated in vertical section an unopened and an opened ascocarp taken from a collection he recorded as *Lophodermium melaleucum* (Fries) de Notaris on *Vaccinium vitis-idaea* (Ericaceae). The structure of the upper wall of the ascocarp shows this species also belongs in group 1.

All the species listed above belong in the *Lophodermium*-complex of Darker (1967), a group characterised by ascocarp shape, and by a saprophytic phase in the life cycle, with ascocarps developing only on dead, fallen leaves or twigs. The four genera in this group were distinguished by ascus and ascospore shape (Darker 1967). Although spore shape as a generic character in the Rhytismataceae has been rejected by some authors (DiCosmo et al. 1984 : 181), it is still widely used in this family because no satisfactory alternative is available (Cannon & Minter 1986). Using the generic concepts developed by Darker (1967), *Meloderma richeae* is for now probably best placed in *Meloderma*, as was concluded by Parbery & Minter (in Minter & Hettige 1983). The closely related *M. dracophylli* must be placed in the same genus.

If it is accepted that the correlation of ascocarp developmental features with host preference is a better indicator of relationship than ascospore shape, then results of the present study suggest that *Meloderma* and *Lophodermium* as at present circumscribed are heterogeneous. The present generic groups, although convenient and easy to use, hide rather than reflect natural relationships amongst the Rhytismataceae.

Figs 9-15 Macroscopic appearance of ascocarps (all x15). **Fig 9.** *Meloderma richeae* (IMI 129993). **Fig 10.** *Meloderma dracophylli* (PDD 44481). **Fig 11.** *Lophodermium sphaerioides* (IMI 23119c). **Fig 12.** *Lophodermium pyrolae* (BPI). **Fig 13.** *Meloderma desmazieresii* (PDD 25636). **Fig 14.** *Lophodermium pinastri* (PDD 45578). **Fig 15.** *Lophodermium conigenum* (PDD 43768).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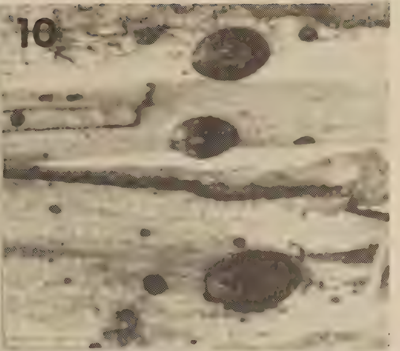
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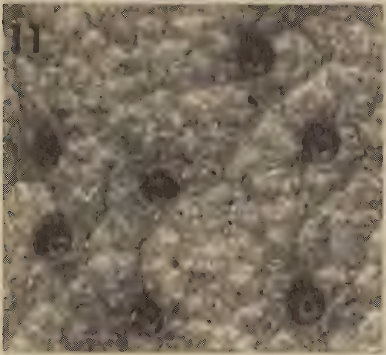
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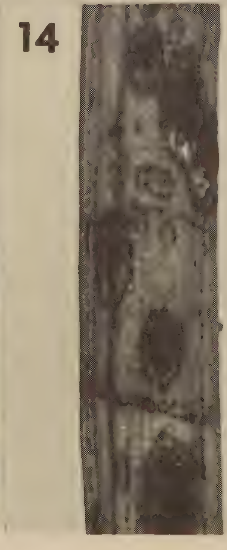
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DERMOCYBE (CORTINARIACEAE, AGARICALES): NORTH AMERICAN NAMES - NEW COMBINATIONS, SYNONYMS AND NOTES

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ABSTRACT

Nineteen North American Dermocybe names are reviewed and seventeen new combinations made in this genus. Cortinarius psammophilus is considered a synonym of Dermocybe aureifolia and Dermocybe croceofolia is made a synonym of Dermocybe malicoria.

INTRODUCTION

Recent investigators studying Dermocybe, consider it to be either a subgenus in Cortinarius or an autonomous genus. Its status as a genus is based primarily on the presence of certain anthraquinonic pigments, which are characteristic for and often exclusive to Dermocybe (Moser 1972, 1983; Keller 1979, 1982; Keller and Ammirati 1983; Kidd et al., 1985; Singer 1986; Gill and Steglich 1987; Ammirati 1988, 1989).

With the exception of Earle (1909), North American agaricologists traditionally have considered Dermocybe to be a subgenus or section within the genus Cortinarius. For example, Peck 1873, 1889, 1890; Earle 1902a, 1902b; Kauffman 1907, 1918, 1921, 1925, 1932; Smith 1939, 1944; Ammirati and Smith 1969, 1972, 1977, 1978, 1984; Ammirati and Gilliam 1975; Ammirati 1975, 1983; Keller and Ammirati 1983; and Robar et al. 1981.

Recent European investigators working on Dermocybe have considered it to be either a subgenus of Cortinarius, these include Kühner and Romagnesi (1953), Orton (1958)

Høiland (1984, 1985), Kidd et al. (1985), and Watling et al. (1986), or a separate genus, for example Moser (1967, 1972, 1973, 1974a, 1974b, 1976, 1978, 1983), Moser and Horak (1975), Keller (1979, 1982) and Keller and Ammirati (1983).

In two recent papers (Ammirati 1988, 1989), and here, the author recognizes *Dermocybe* as a genus. In this paper most of the North American species in the sections *Dermocybe*, *Holoxanthae* and *Malicoriae* are considered. *Cortinarius pseudotubarius* Robar, Harrison and Grund and *C. rubeus* Robar, Harrison and Grund, both are species of *Dermocybe*. However, the author has not yet studied the type material of these species and, therefore, has not transferred them to *Dermocybe* here. Species in the section *Sanguineae* are treated in Ammirati (1989). The new combinations are made so that the names can be used in *Dermocybe*. In addition, a few notes and some synonyms are presented. The sections, and the species within them, are listed alphabetically.

NAMES

DERMOCYBE (Fr.) Wünsche, Die Pilze. Teubner, Leipzig, p. 87. 1877.
Type species: *Dermocybe cinnamomea* (L.:Fr.) Wünsche

Subgenus Dermocybe

Section Dermocybe

Dermocybe aurantiobasis (Ammirati and Smith) Ammirati, comb. nov.
Basionym: *Cortinarius aurantiobasis* Ammirati and Smith, Mycotaxon 5(2):382-385, Fig. 1. 1977. (Holotype: A. H. Smith 24213, Still Creek, Mt. Hood National Forest, Clackamas Co., Oregon, October 6, 1946, MICH!)

Dermocybe aureifolia (Peck) Moser var. *aureifolia*, Schweiz. Z. Pilzk. 52:100-101. 1974.
Basionym: *Cortinarius aureifolius* Peck, Ann. Rep. New York State Mus. 38:89. 1885. (Holotype: C. H. Peck, Karner, Albany Co., New York, October, 1884, NYS!)
Synonyms: *Cortinarius psammophilus* Ammirati and Smith, Mich. Bot. 8:178-180, Figs. 2-4. 1969. (Holotype: J. F. Ammirati 2693, Fralick's Tree Farm, Hell, Livingston Co., Michigan, October 25, 1968, MICH!)

Cortinarius aureifolius var. psammophilus (Ammirati and Smith) Ammirati in Ammirati and Gilliam, Sydowia, Beihefte zur Nova Hedwigia 51:47-50, Figs. 1,3-5,8,9,11,12. 1975.

Ammirati and Smith (1969) and Ammirati and Gilliam (1975) separated Dermocybe aureifolia from Cortinarius psammophilus primarily on differences in coloration of the basidiomata. These differences, which seem to be related to the age and/or developmental stage of the basidiomata, are not significant enough to maintain them as separate taxa.

Dermocybe aureifolia var. hesperia (Ammirati in Ammirati and Gilliam) Ammirati, comb. nov.
Basionym: Cortinarius aureifolius var. hesperius Ammirati in Ammirati and Gilliam, Sydowia, Beihefte zur Nova Hedwigia 51:45-46. 1975. (Holotype: J. F. Ammirati, Jr. 6123, Sand Lake, Tillamook Co., Oregon, November 12, 1971, MICH!)

Dermocybe cascadensis (Ammirati and Smith) Ammirati, comb. nov.
Basionym: Cortinarius cascadensis Ammirati and Smith, Mycotaxon 7(2):257-260, Fig. 1. 1978. (Holotype: J. F. Ammirati, Headquarters, Cascade Head Experimental Forest, Lincoln Co., Oregon, November 14, 1971, MICH!)

Dermocybe chrysolita (Kauffman) Ammirati, comb. nov.
Basionym: Cortinarius chrysolitus Kauffman, Bull. New York State Mus. 179:101. 1915. (Holotype: C. H. Kauffman, North Elba, Essex Co., New York, September 19, 1914, MICH!)

Dermocybe humboldtensis (Ammirati and Smith) Ammirati, comb. nov.
Basionym: Cortinarius humboldtensis Ammirati and Smith, Mycotaxon 5(2):385-387, Fig. 3. 1977. (Holotype: A. H. Smith 56392, Trinidad, Humboldt Co., California, December 6, 1956, MICH!)

Dermocybe huronensis (Ammirati and Smith) Ammirati var. huronensis, comb. nov.
Basionym: Cortinarius huronensis Ammirati and Smith var. huronensis, Michigan Bot. 11:20-21, Fig. 1. 1972. (Holotype: J. F. Ammirati, Jr. 5403, Canyon Lake, Huron Mountain Club, Marquette Co., Michigan, September 23, 1970, MICH!)

Dermocybe huronensis var. *olivacea* (Ammirati and Smith) Ammirati, comb. nov.

Basionym: *Cortinarius huronensis* var. *olivaceus* Ammirati and Smith, Michigan Bot. 11:21-22, Figs. 2,11. 1972. (Holotype: A. H. Smith, 64679, Mud Lake Bog, Washtenaw Co., Michigan, October 14, 1961, MICH!)

Dermocybe palustris (Moser) Moser is the same as *Dermocybe huronensis* according to Høiland (1985). However, the former combination by Moser (1967) is invalid and can not be used because it was based on an invalidly published name (Høiland, 1985).

Dermocybe idahoensis (Ammirati and Smith) Ammirati, comb. nov.

Basionym: *Cortinarius idahoensis* Ammirati and Smith, Mycotaxon 7(2):260-263, Figs. 2,3. 1978. (Holotype: A. H. Smith 71073, Priest Lake, Bonner Co., Idaho, October 5, 1964, MICH!)

Dermocybe incognita (Ammirati and Smith) Ammirati, comb. nov.

Basionym: *Cortinarius incognitus* Ammirati and Smith, Michigan Bot. 11:18-20, Figs. 3,10. 1972. (Holotype: J. F. Ammirati, Jr. 1354, Hell, Livingston Co., Michigan, October 20, 1967, MICH!)

Dermocybe olivaceopicta (Ammirati and Smith) Ammirati, comb. nov.

Basionym: *Cortinarius olivaceopictus* Ammirati and Smith, Mycotaxon 5(2):387-389, Fig. 5. 1977. (Holotype: A. H. Smith 79016, Van Duzer Corridor, Tillamook Co., Oregon, October 13, 1970, MICH!)

Dermocybe pellstoniana (Ammirati and Smith) Ammirati, comb. nov.

Basionym: *Cortinarius pellstonianus* Ammirati and Smith, Michigan Bot.11:13-15, Fig. 4. 1972. (Holotype: A. H. Smith 66395, Pellston, Emmet Co., Michigan, September 30, 1962, MICH!)

Dermocybe subcroceofolia (Ammirati and Smith) Ammirati var. *subcroceofolia*, comb. nov.

Basionym: *Cortinarius subcroceofolius* Ammirati and Smith, var. *subcroceofolius*, Michigan Bot. 11:15-17, Figs. 5,9. 1972. (Holotype: J. Ammirati, Jr. 5310, Big Bay

Point, Marquette Co., Michigan, September 16, 1970, MICH!)

Dermocybe subcroceofolia var. *sordidipes* (Ammirati and Smith) Ammirati, comb. nov.
Basionym: *Cortinarius subcroceofolius* var. *sordidipes* Ammirati and Smith, Michigan Bot. 11:17-18, Fig. 6. 1972. (Holotype: J. F. Ammirati Jr. 5456, Mass, Ontonagon Co., Michigan, September 28, 1970, MICH!)

Dermocybe thiersii (Ammirati and Smith) Ammirati, comb. nov.
Basionym: *Cortinarius thiersii* Ammirati and Smith, Mycotaxon 5(2):389-390, 392-393, Fig. 2. 1977. (Holotype: H. D. Thiers 12633, Pinecrest Campground, Tuolumne Co., California, June 14, 1965, SFSU!)

Dermocybe zakii (Ammirati and Smith) Ammirati, comb. nov.
Basionym: *Cortinarius zakii* Ammirati and Smith, Mycotaxon 5(2):393-396, Fig.4. 1977. (Holotype: J.F. Ammirati, Jr. 6175, Mary's Peak, Benton Co., Oregon, November 16, 1971, MICH!)

Section Holoxanthae Moser, Schweiz.Z.Pilzk.50:162. 1972.
Type species: *Dermocybe holoxantha* Gruber and Moser

Dermocybe tubaria (Ammirati and Smith) Ammirati var. *tubaria*, comb. nov.
Basionym: *Cortinarius tubarius* Ammirati and Smith var. *tubarius*, Michigan Bot. 11:22,24, Fig.7,12. 1972. (Holotype: A. H. Smith 64673, Mud Lake Bog, Washtenaw Co., Michigan, October 14, 1961, MICH!)

Dermocybe tubaria var. *luteofolia* (Ammirati and Smith) Ammirati, comb. nov.
Basionym: *Cortinarius tubarius* var. *luteofolius* Ammirati and Smith, Michigan Bot. 11:24, Fig. 8. 1972. (Holotype: J. F. Ammirati, Jr,5055, Chicken Farm, near Ives Lake, Huron Mountain Club, Marquette Co., Michigan, August 27, 1970, MICH!)

Cortinarius sphagneti Orton (=*Dermocybe palustris* var. *sphagneti* (Orton) Moser), *Dermocybe sphagnogena* Moser, and *Dermocybe vulcanica* Bon, are the same as *D. tubaria* (Høiland, 1984). *Cortinarius sphagneti* is a later homonym of *Cortinarius sphagneti* Singer in Frejndling (1949) and can not be used for the species described by P. D. Orton (Høiland, 1985).

Section Malicoriae Moser, Schweiz. Z. Pilzk. 50:162. 1972. Type species: Dermocybe malicoria (Fr.) Ricken

Dermocybe croceofolia (Peck) Moser, Schweiz. Z. Pilzk. 52:99-100. 1974.
Basionym: Cortinarius croceofolius Peck, Bull. New York State Mus. 150:26. 1911. (Holotype: C. H. Peck, North Elba, Essex Co., New York, September 9, 1910, NYS!)

Dermocybe croceofolia is a synonym of Dermocybe malicoria (Høiland, 1984; Ammirati, 1988). Ammirati (1972) maintained them as separate species on the basis of minor differences in coloration. However, additonal studies have shown this to be incorrect.

ACKNOWLEDGEMENTS

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RESURRECTION OF THE LICHEN GENUS *PLEUROSTICTA* PETRAK (PARMELIACEAE: ASCOMYCOTINA)

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ABSTRACT : The parmelioid genus *Melanelia* is shown to be heterogeneous and the genus *Pleurosticta* (the *M. acetabulum* group) is segregated, because of a pored epicortex, bacilliform to fusiform conidia and a simple chemistry. The new combinations *Pleurosticta acetabulum* (Neck.) Elix & Lumbsch and *P. koflerae* (Clauzade & Poelt) Elix & Lumbsch are made.

The generic concepts in lichens are currently in a state of flux, especially in the crustose genera *Lecanora* Ach. and *Lecidea* Ach. (Hafellner 1984; Hertel 1984, 1987) and the macrolichen family Parmeliaceae (Hale 1984a). While special emphasis is accorded to the different ascus structure in the crustose genera, these are apparently uniform within *Parmelia s. lat.* However, Hale (1974a, b, c, d; 1976; 1985), Esslinger (1978), Sipman (1980), Culberson & Culberson (1981) and Krog (1982) have segregated groups from *Parmelia s. str.* which are based on chemical, geographical and morphological, as well as anatomical characters.

Although these new genera are recognized by many lichenologists, they have not yet been accepted fully by a number of European workers (e.g. Poelt & Vězda 1981; Hawksworth et al. 1980; Santesson 1984; Clauzade & Roux 1985; Eriksson & Hawksworth 1986). These authors do not consider that such generic splits are justified as "no correlations with ascoscarp or pycnidial differences have been established" (Hawksworth et al. 1980: 2).

However, further investigation has shown that even these segregates are heterogeneous and consequently further new genera have been proposed (Hale 1984a, 1986a, b; Elix et al. 1986b; Elix & Hale 1987).

In our opinion the main disagreement in this debate is not the grouping of taxa, but their ranking. After the more recent splits most, but not all of the parmelioid genera are homogeneous. Indeed, this fact is not questioned by those contesting the new generic concepts, who simply argue that the differences between these natural groups do not justify a separation at generic level.

Consequently a comprehensive comparison of the generic splits from *Parmelia s. str.* and their relationship to one another is needed urgently. Thus a phenetic and cladistic analysis of the parmelioid genera with a pored epicortex is currently being prepared by one of us (HTL).

While preparing the data matrix for the analysis it became evident that some of the genera described in the "brown Parmeliae" by Esslinger (1978) are heterogeneous assemblages. While the differences between *Neofuscelia s. str.* and *Xanthoparmelia* may be questioned by some, the genus *Melanelia* included both species with pseudocyphellae and pored epicortices.

Hale (1981) demonstrated the essential difference between pseudocyphellate and pored epicortices within the Parmeliaceae, and showed that segregates based on such a difference correlated with geographical, morphological and chemical characters. The evolutionary significance of these characters also was considered.

In this paper we discuss the *Melanelia acetabulum* group, which previously was shown to be an anomalous element among the brown Parmeliae (Clauzade & Poelt 1961) and propose its segregation from *Melanelia s. str.* at generic level.

Material and Methods

List of specimens photographed: *Allantoparmelia alpicola* - Canada, NWT, Pr. Patrick Island, Mould Bay, *S. D. MacDonald s.n.,* 30.vi.1952 (MB). *Flavoparmelia rutidota* - Australia, ACT, Gudgenby River gorge, 27 km S of Canberra, *H. Streimann & H. T. Lumbsch 5628c,* 9.ix.1987 (herb. Lumbsch). *Melanelia disjuncta* - USA, New York, Essex Co., Keene Talus slope of Giant Mt. Rt. 73, *C. K. Schmitt 4203,* 18.ix.1983 (herb. Lumbsch). *Melanelia panniformis* - Canada, Alberta, Banff Nat. Park, NE of Morraine Lake, *B. Ryan 14111*, 26.vii.1985 (herb. Lumbsch). *Melanelia stygia* - Switzerland, Silvrettagruppe, Fimbertal, *H. M. Jahns 101g*, 30.vii.1964 (MB). *Neofuscelia pulla* - France, Finistere, Quiberon, near St. Joachim, *E. Mietzsch & H. T. Lumbsch 4575g*, 15.ix.1986 (herb. Lumbsch). *Pleurosticta acetabulum* - FRG, Baden-Württemberg, Klosterreichenbach, *H. T. Lumbsch 773a*, 12.iv.1983 (herb. Lumbsch); Niedersachsen, Utarp, *H. T. Lumbsch 29a,* 18.v.1980 (herb. Lumbsch). Scanning electron microscopy was carried out according to Lumbsch & Kothe (1988), but material was fixed in 8% glutaraldehyde for 12 h.

High pressure liquid chromatography (HPLC) was carried out according to Lumbsch & Elix (1986).

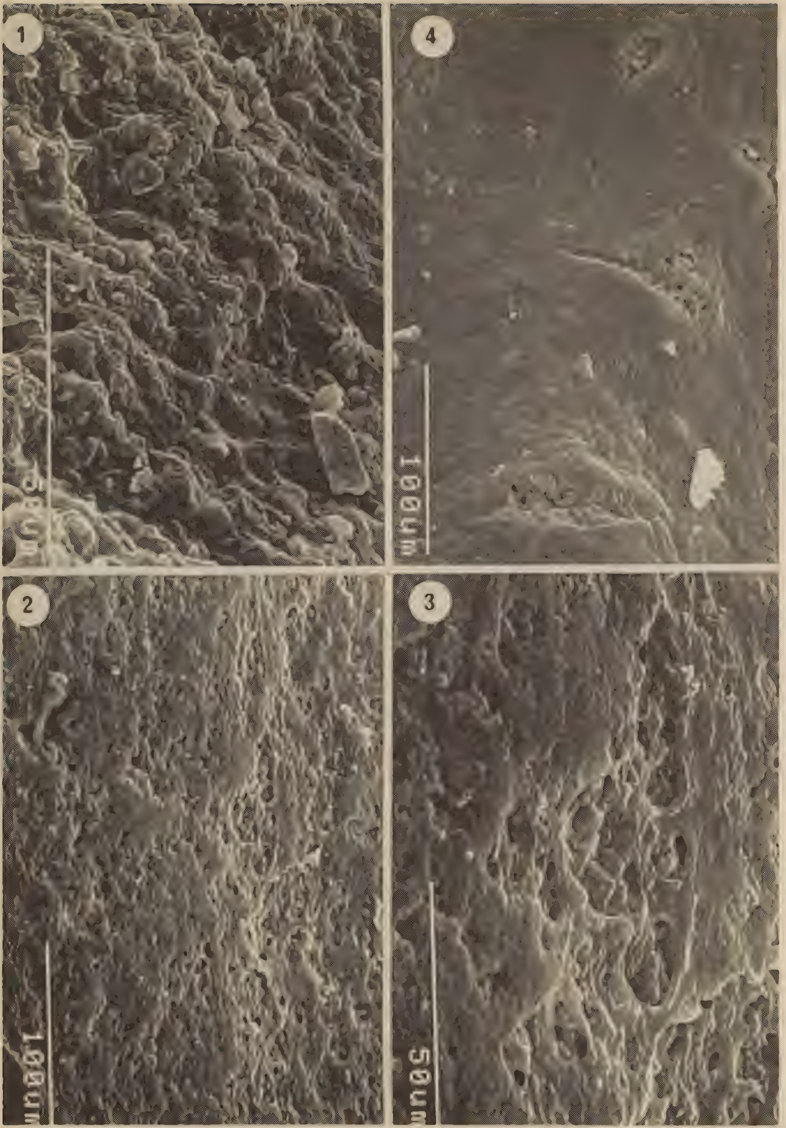
Results and Discussion

In the present work SEM studies of *Melanelia acetabulum* (Neck.) Essl. and *M. koflerae* (Clauzade & Roux) Essl. have established the presence of a pored epicortex (Figures 9-12), while in other species of *Melanelia*, including the type species *M. stygia*, a non-pored epicortex was visible (Figures 4-7). Pseudocyphellae may occur in the latter and other species (Figures 4-7). If a pored epicortex is accepted as an important generic character within the Parmeliaceae, the genus *Melanelia*, as circumscribed by Esslinger (1978), cannot be accepted. On the other hand, it is not possible to include *M. acetabulum* and *M. koflerae* in another genus of the brown Parmeliae (Table 1).

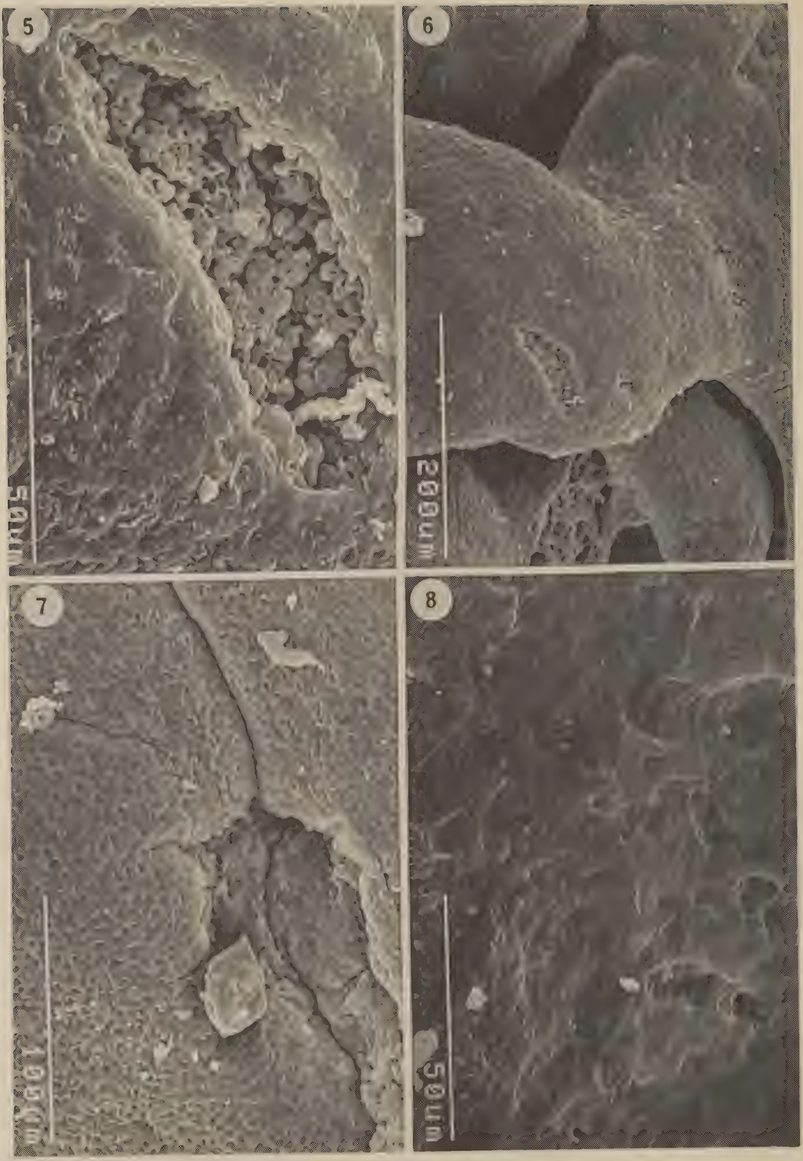
In *Allantoparmelia* (Figure 1), the lower surface lacks rhizines and the differences in spore size, conidial shape and distribution show that these taxa are not closely related. Chemically *Allantoparmelia* is characterized by the presence of β-orcinol benzylesters (alectorialic acid and barbatolic acid). Moreover, *Allantoparmelia* lacks both pseudocyphellae and a pored epicortex and thus does not seem to be related to other *Parmelia s. lat.* segregates.

Neofuscelia s. str. (Figure 8) differs from the *M. acetabulum* group in spore size, conidial shape, the major centres of distribution and chemistry.

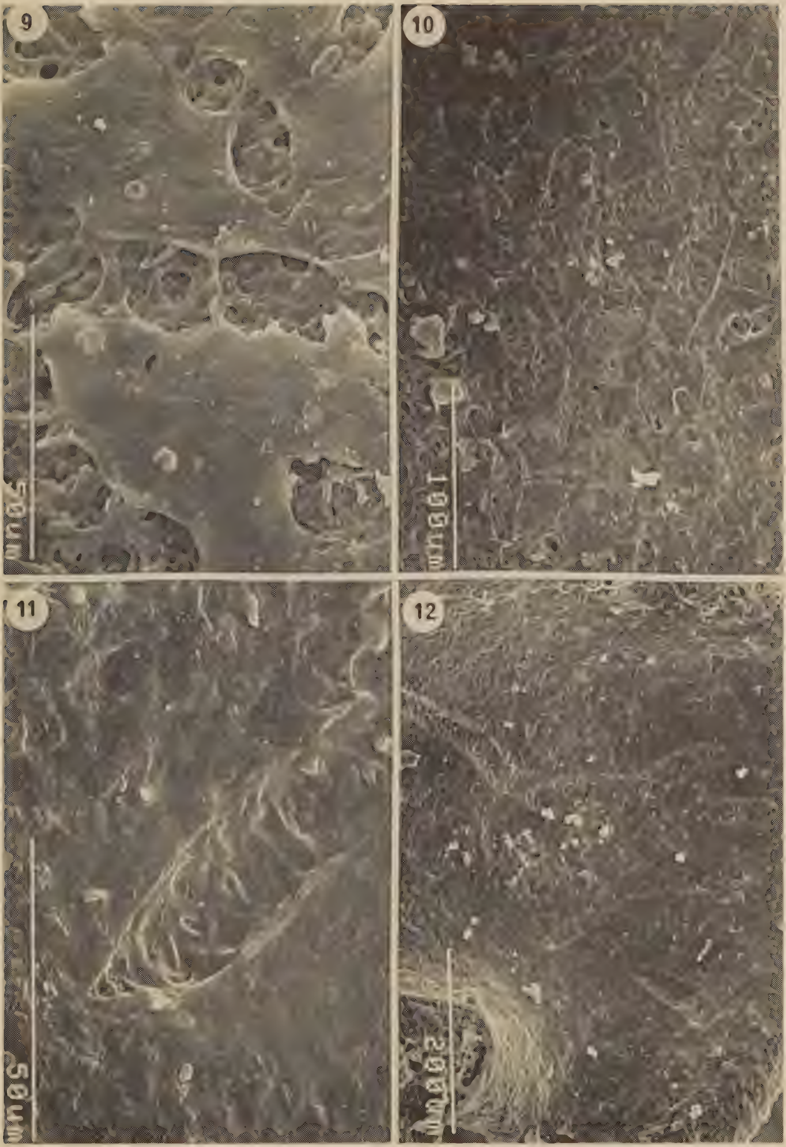
Other parmelioid genera with a pored epicortex, eciliate lobes and bacilliform or fusiform conidia include *Concamarella* Culb. & Culb., *Everniastrum* Hale ex Sipman, *Flavoparmelia* Hale, *Paraparmelia* Elix & Johnston, *Relicinopsis* Elix & Verdon, *Xanthomaculina* Hale and *Xanthoparmelia* Hale, but all these genera differ in significant characters from the *M. acetabulum* group.


1
4
100um
2
100um
3
50um
50um

Figures 1-4. Thallus surface (SEM). 1, *Allantoparmelia alpicola* ; 2-3, *Flavoparmelia rutidota* (with epicortical pores); 4, *Melanelia disjuncta* (with pseudocyphellae).


5
50µm
6
200µm
7
100µm
8
50µm

Figures 5-8. Thallus surface (SEM). 5-6, *Melanelia panniformis* (with pseudocyphellae); 7, *Melanelia stygia* (with pseudocyphellae); 8, *Neofuscelia pulla* (with epicortical pores).


9
50um
10
100um
11
50um
12
200um

Figures 9-12. Thallus surface (SEM). *Pleurosticta acetabulum* (with epicortical pores). 9-10, *H. T. Lumbsch 773a;* 11-12, *H. T. Lumbsch 29a.*

TABLE 1

Comparison of Pleurosticta with other Genera of the 'Brown Parmeliae'

Character	*Allantoparmelia*	*Melanelia s.str.*	*Neofuscelia s. str.*	*Pleurosticta*
Pseudocyphellae	-	+	-	-
Pored Epicortex	-	-	+	+
Conidia (µm)	bacilliform - bifusiform	various	bifusiform	bacilliform - fusiform
Spores (µm)	7 - 12 x 4 - 7	7 - 13 x 4 - 7	7 - 13 x 4 - 7	12 - 16 x 6 - 11
Rhizines	-	+	+	+
Distribution	arctic - boreal	temperate	arid & semi-arid	temperate
Chemistry				
Orcinol depsides	+	+	+	-
Orcinol depsidones	+	-	+	-
β-orcinol depsides	-	+	+	-
β-orcinol depsidones	-	+	+	+
β-orcinol benzylesters	+	-	-	-
Fatty acids	+	+	+	-

Concamarella and *Xanthomaculina* have a special structure of the upper cortex, which distinguishes them from all other parmelioid genera (Culberson & Culberson 1981, Hale 1985).

Most species of *Everniastrum* have bifusiform conidia and the genus has a neotropical distribution. Moreover, the chemistry is distinctly more complex and the lobes are convex, narrow, linear-elongate and dichotomously-branched (Sipman 1986).

Relicinopsis clearly differs as it has smaller spores, a specialized ecology (canopy branches of primary tropical rainforests), a different chemistry and an East Asian distribution (Elix et al. 1986b).

Representatives of the genera *Paraparmelia* and *Xanthoparmelia* also have smaller spores than those observed in the *M. acetabulum* group, posses atranorin or usnic acid in the upper cortex and have their major distribution in semi-arid and arid regions (Elix et al. 1986a, 1986b).

The only genus which has similar spores and conidia to the *M. acetabulum* group is *Flavoparmelia* (Figures 2 & 3). However, in *Flavoparmelia* the majority of species have bifusiform conidia, soralia are common and true isidia are unknown. Also the genus is cosmopolitan and has a different chemistry. Thus species of *Flavoparmelia* contain usnic acid, ± atranorin in the upper cortex; and β-orcinol depsides or β-orcinol depsidones, pigments and fatty acids in the medulla (Hale 1986b); while the *M. acetabulum* group lacks cortical constituents and contains only the β-orcinol depsidones, norstictic acid and salazinic acid in the medulla.

Consequently, we propose to distinguish the *M. acetabulum* group at generic level, based on the distinctive morphological, chemical and geographical differences, as well as spore and conidial characters. The name *Pleurosticta* Petrak, based on the pycnidia of *P. acetabulum* (Santesson 1949), is available. Previously it was proposed that this name be rejected in order to conserve *Melanelia* (Esslinger 1980), but this proposal was subsequently defeated (Korf 1988). However the generic names *Melanelia* and *Pleurosticta* were based on different types, namely *M. stygia* and *P. acetabalum* respectively. Our studies above have now shown that there is no need for conservation of the name *Melanelia,* as the congeneric status of these two species was based on a misinterpretation of the morphological and chemical variation within the brown Parmeliae. Hence *Pleurosticta* can be resurrected.

In these circumstances the following new combinations are necessary:

Pleurosticta acetabulum (Neck.) Elix & Lumbsch **comb. nov.**
Basionym: Lichen acetabulum Neck., Delic. Gallo-Belgic. Silvetsr. **2**: 506 (1768).

Pleurosticta koflerae (Clauzade & Roux) Elix & Lumbsch **comb. nov.**
Basionym: Parmelia koflerae Clauzade & Poelt, Nova Hedwigia **3**: 368 (1961).

Descriptions of both species are given in Esslinger (1977).

ACKNOWLEDGEMENTS

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CHEMICAL VARIATION IN THE LICHEN GENUS *DIPLOICIA* (ASCOMYCOTINA)

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ABSTRACT : An investigation of the chemical constituents present in the *Diploicia canescens* (Dicks.) Massal. species complex indicated that there were three distinct taxonomic entities: *D. canescens* sens. str., *D. subcanescens* (Werner) Hafelln. & Poelt and a new taxon, here described as *D. canescens* ssp. *australasica* Elix & Lumbsch and reported from Australia and New Zealand. Secalonic acid B is reported for the first time from a lichen.

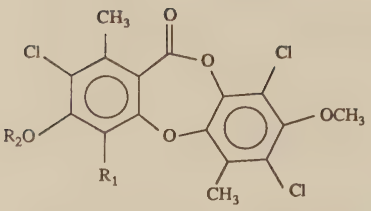
Introduction

The original phytochemical investigations of *Diploicia canescens* (Dicks.) Massal. were undertaken by Nolan and his colleagues in Dublin (Nolan 1934; Nolan *et al.* 1948; Spillane, Keane & Nolan 1936) working on Irish collections of this species. These workers isolated and established the structure of the major depsidone constituent, diploicin (1). Although a second diploicin-like substance was isolated from this source, insufficient material was obtained for structural work.

More recently Llimona, Werner, Lallemant & Boissiere (1976) detected diploicin (1), atranorin (6), chloroatranorin (7), an unidentified triterpene and pigments in collections from France and Spain. Sala, Sargent and Elix (1978, 1981) examined Australian collections of *D. canescens* , and in addition to diploicin (1), atranorin (6), and chloroatranorin (7), they isolated dechlorodiploicin (2), dechloro-*O*-methyldiploicin (3) and the novel phthalides, buellolide (4) and canesolide (5).

Buellolide (4) and canesolide (5) probably arise biosynthetically by catabolism of their cogeneric depsidones. Thus dechlorodiploicin (2) may undergo oxidation of the methyl group in the 1-position, subsequent fission of the depside bond and concomitant recyclization with the formation of the more stable five-membered lactone ring, and ultimately *O*-methylation to yield buellolide (4). Canesolide (5) would arise from diploicin (1) by a similar sequence, but the fission of the depside linkage in this case must be followed by a Smiles rearrangement of the diphenyl ether so-formed [Scheme 1] (Sala, Sargent & Elix 1978, 1981).

Given the highly derived nature of the phthalides (4) and (5), the occurrence of these compounds may well have systematic implications (Elix 1982; Culberson 1986), so their distribution has been studied in the present work.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Cl
O
Cl
OCH$_3$
R$_2$O
O
R$_1$
CH$_3$
Cl

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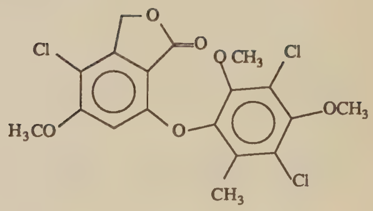
(1)	Cl	H
(2)	H	H
(3)	H	CH$_3$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O
Cl
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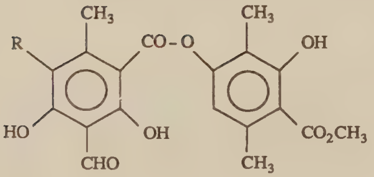
Cl
OCH$_3$
H$_3$CO
O
Cl
CH$_3$

(4)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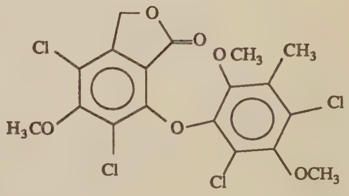
R
CO-O
OH
HO
OH
CO$_2$CH$_3$
CHO
CH$_3$

(6) R = H

(7) R = Cl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Cl
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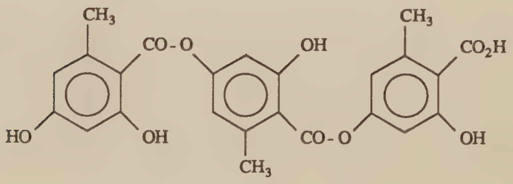
(5)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CH$_3$
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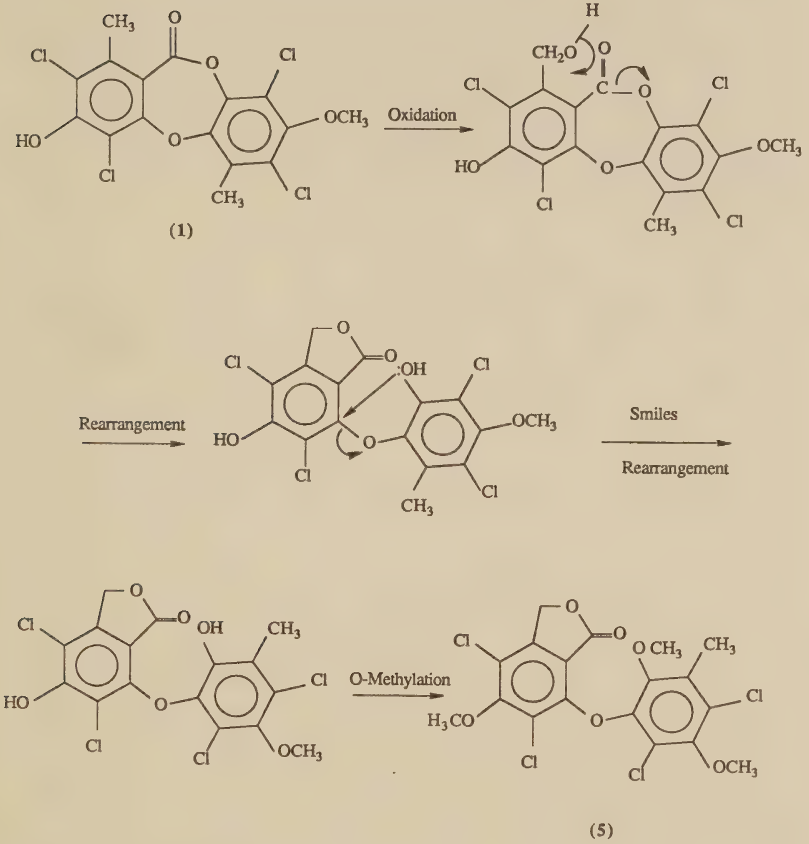
HO
OH
CO-O
OH
CH$_3$

(8)

Scheme 1. Proposed Biosynthesis of Canesolide (5)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HO
O
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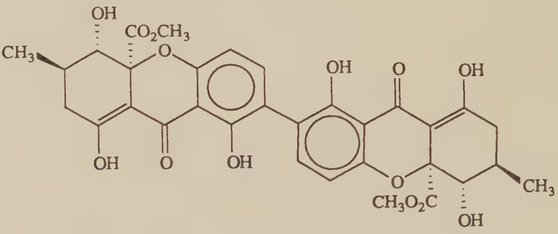
Cl
CH$_3$
Cl
(1)
Oxidation
H
CH$_2$O
O
Cl
C
O
Cl
OCH$_3$
HO
O
Cl
CH$_3$
Cl
Rearrangement
O
O
Cl
:OH
Cl
OCH$_3$
HO
O
Cl
CH$_3$
Cl
Smiles
Rearrangement
O
O
Cl
OH
CH$_3$
Cl
HO
O
Cl
Cl
OCH$_3$
O-Methylation
O
O
Cl
O CH$_3$
CH$_3$
Cl
H$_3$CO
O
Cl
Cl
OCH$_3$
(5)

Phytochemistry of *Diploicia canescens sens. lat.*

Fragments of 44 specimens of the following taxa were examined: *Diploicia canescens* (Dicks.) Massal. from Europe (9) and North America (1); *Diploicia canescens sens. lat.* from Australia (23) and New Zealand (11); *Diploicia subcanescens* (Werner) Hafelln. & Poelt from Europe and Macaronesia (3). The lichen fragments were freed of all obvious organic substrate material and extracted with warm acetone for thin layer chromatography (t.l.c.), or with warm methanol for high performance liquid chromatography (h.p.l.c.). T.l.c. analyses were conducted using the standardized methodology developed by Culberson (Culberson 1972; Culberson & Johnson 1982; Culberson, Culberson & Johnson 1981; Elix, Johnston & Parker 1987, 1988). H.p.l.c. was performed using a Perkin-Elmer Series 1LC pump fitted with a HS-5C18 column and a LC-85 spectrometric detector operating at 254 nm. Elution was effected with 90% methanol-water containing orthophosphoric acid (80µl/400ml) with a flow rate of 0.6 ml min^{-1} (Lumbsch & Elix 1985).

A total of 11 identifiable substances were detected. In addition to the compounds (1) - (7) mentioned above, these included the orcinol tridepside, gyrophoric acid (8), and the pigments secalonic acid A (9), secalonic acid B (10) and secalonic acid C (11). This is the first confirmed occurrence of secalonic acid B (10) in lichens - although it been known for some time in non-lichenized fungi (Franck *et al.* 1966). The standardized chromatographic data for these compounds are listed in Table 1. Throughout the present work chemical constituents were identified by correlation of t.l.c. and h.p.l.c. data as well as by comparison with authentic samples.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CH3
O
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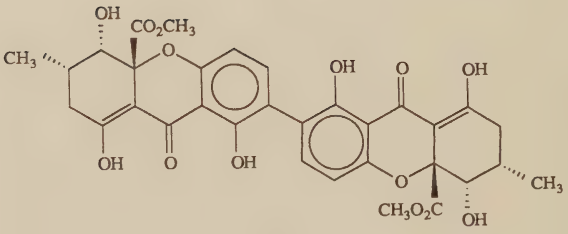
O
CH3
CH3O2C
OH

(9)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O
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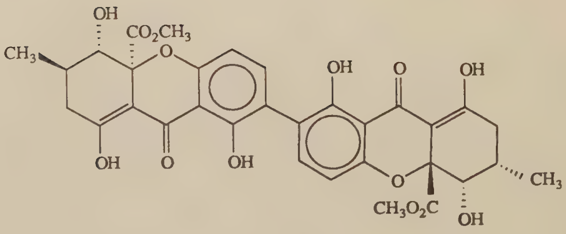
O
CH3
CH3O2C
OH

(10)


OH
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CH3
O
OH
O
OH
OH
O
OH
O
CH3
CH3O2C
OH

(11)

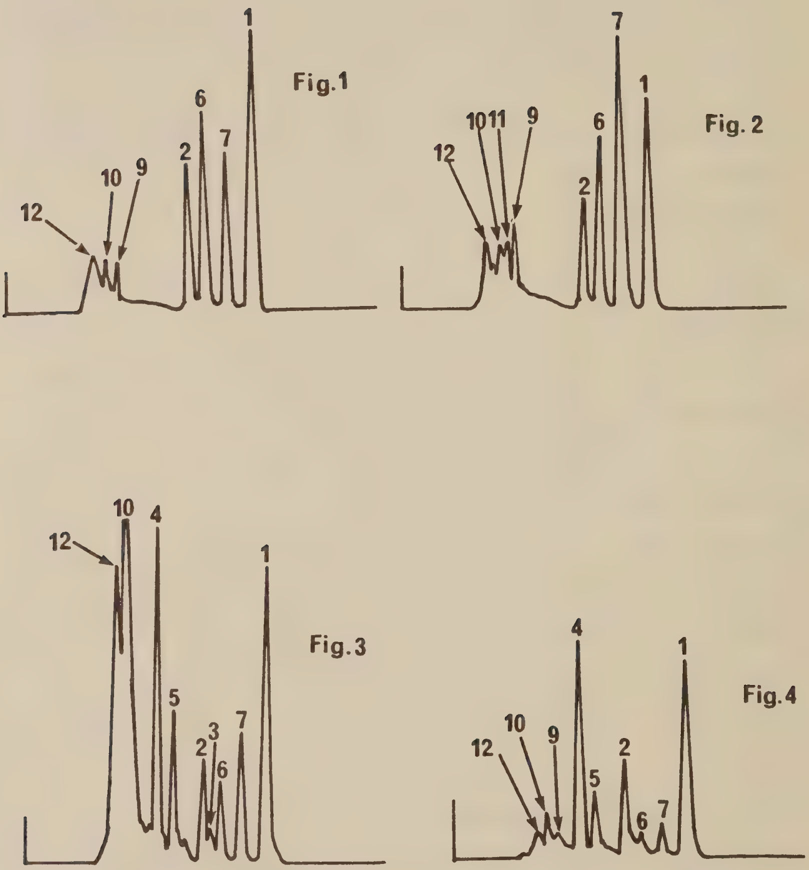
Table 1. Standardized Chromatographic Data for *Diploicia* Metabolites

Standard R_F values (x 100) were determined in five independent t.l.c. solvent systems: (A) toluene / dioxane / acetic acid (180 : 45 : 5); (B) hexane / diethyl ether / formic acid (130 : 80 : 20); (B*) hexane / *t*-butyl methyl ether / formic acid (140 : 72 : 18); (C) toluene / acetic acid (170 : 30); (E) ethyl acetate / cyclohexane (25 : 75); (G) toluene / ethyl acetate / formic acid (139 : 83 : 8). Standard R_T values in h.p.l.c. are given in minutes.

Compound R_F	(A)	(B)	(B*)	(C)	(E)	(G)	R_T (min.)
Diploicin (1)	65	79	65	67	13	--	9.15
Dechlorodiploicin (2)	58	--	53	62	28	--	6.75
Dechloro-*O*-methyl diploicin (3)	74	--	58	83	55	--	6.88
Buellolide (4)	72	--	45	63	51	--	4.86
Canesolide (5)	73	--	63	71	45	--	5.46
Atranorin (6)	75	78	73	79	57	--	7.37
Chloroatranorin (7)	74	79	73	81	30	--	8.19
Gyrophoric Acid (8)	24	42	42	24	--	--	4.32
Secalonic Acid A (9)	39	16	13	28	--	37	4.22
Secalonic Acid B (10)	44	--	21	37	--	53	3.68
Secalonic Acid C (11)	42	--	17	32	--	45	3.87
Unknown Pigment	23	--	15	23	--	--	3.24
Norstictic Acid (Standard)	40	29	32	30	--	57	3.91

Chemotaxonomy of *Diploicia canescens sens. lat.*

The present study showed a distinct and consistent chemical demarcation between *D. canescens s. str.* and the eastern Australian and New Zealand specimens of *D. canescens s. l.* (compare Figures 1, 2 with Figures 3, 4). The concentration of the secalonic acid pigments varied with the locality in both taxa. These compounds appear to be typical accessory substances - of variable concentration and of little or no taxonomic value. In contrast, all the eastern Australian and majority of New Zealand collections contained significant quantities of buellolide (4) and canesolide (5), while these substances were absent in material from the Northern Hemisphere. The chemical profile of American collections of *D. canescens* previously has been reported to be identical with that of the European counterparts (Bratt 1984). Since the production of the substances (4) and (5) requires additional steps in the biosynthetic pathway (and probably an additional oxidative enzyme), the east Australasian taxon can be considered as chemically more advanced than that producing the depsidones (1-3) alone.



Figures 1-4. H.p.l.c. traces of *Diploicia canescens s. lat.*: 1, *D. canescens sens. str.* (ex. Handorf in MSTR); 2, *D. canescens s. str.* (*P. Dreesen* in MSTR); 3, *D. canescens* ssp. *australasica* (holotype in CBG); 4, *D. canescens* ssp. *australasica* (*Elix 4677* in ANUC).

Index to H.p.l.c. Peaks: (1) diploicin; (2) dechlorodiploicin; (3) dechloro-*O*-methyldiploicin; (4) buellolide; (5) canesolide; (6) atranorin; (7) chloroatranorin; (8) gyrophoric acid; (9) secalonic acid A; (10) secalonic acid B; (11) secalonic acid C; (12) unknown pigment(s).

As a consequence we recognize the east Australasian material as a distinct taxon, and because of the complementary nature of the chemical constituents and the absence of consistent morphological differences, it has been given subspecific status following the proposal of Pisút (1968). Even so this subspecies does exhibit different habitat preferences to *D. canescens s. str.* (generally saxicolous whereas *D. canescens s. str.* is usually corticolous in Australasia).

Diploicia canescens (Dicks.) Massal. ssp. ***australasica*** Elix & Lumbsch, ssp. nov. Fig. 7

Species cum thallo ut in *Diploicia canescens* sed ab hac buellolidinum et canesolidinum continente differt.
Type. Australia. New South Wales. On rocks on coastal cliffs, Mystery Bay, *J. A. Elix 2087*, 25.iv.1976; CBG-holotype, MEL-isotype.

Thallus squamulose to subcrustose, orbicular, adnate on rocks or rarely old wood, white to grey-white, becoming pale pink or reddish, eventually darker centrally, to 5 cm in diameter, lobate-effigurate at the circumference. *Lobes* radiate-plicate, contiguous, convex, 0.8-1.2 mm wide, ± areolate in the centre. *Upper surface* smooth or with granular, white pruina, particularly towards the apices, sorediate; *soralia* in scattered erose patches, mainly laminal, soredia white, coarsely granular to farinose; medulla white, irregularly pigmented yellow, orange or pale red. *Lower surface* ivory to pale brown, apparently ecorticate. *Apothecia* not seen in Australasian material.
Chemistry. Cortex K+ yellow; medulla K+ yellow, C-, P+ yellow ; containing atranorin, chloroatranorin, diploicin, dechlorodiploicin, dechloro-*O*-methyldiploicin, buellolide, canesolide, secalonic acid A, secalonic acid B, secalonic acid C, unknown pigment(s).

Specimens Examined
AUSTRALIA. New South Wales. On rocks along the foreshore, Tuross Heads, *J. A. Elix 2085,* 24.iv.1976 (ANUC); on fence post on top of cliff, Camel Rock, 5 km north of Bermagui, *J. A. Elix 4575,* 4.iii.1978 (ANUC); on sandstone rocks in dry sclerophyll forest, Mt. Bouddi, Bouddi National Park, *J. A. Elix 4677,* 7.v.1978 (ANUC).
Australian Capital Territory. On moist rock ledges along river bank, Molonglo Gorge Reserve, 14 km east of Canberra, *J. A. Elix 11764, P. W. James & D. Verdon,* 27.i.1984 (ANUC).
Tasmania. On rock, southern side of Southern Knob, Curtis Island, Bass Strait, *Rex Filson 12182*, 10.ii.1971 (MEL); on calcareous sandstone, Hogan Island, Hogans Group, Bass Strait, *G. Hope*, 25.i.1968 (MEL); on dead wood of *Leucopogon parviflorus*, Sentinel Island, Furneaux Group, Bass Strait, *J. S. Whinray*, 27.viii.1966 (MEL); on limestone outcrop, West Cove, Erith Island, Kents Group, Bass Strait, *J. S. Whinray*, 16.xii.1970 (MEL); on bark of dead *Albizzia*, Craggy Island, Bass Strait, *J. S. Whinray*, 31.iii.1972 (MEL); on coastal granite rocks, west coast of Mt. Chappell Island, Furneaux Group, Bass Strait, *J. S.Whinray*, 12.viii.1973 (MEL); on coastal granite rocks, west coast of Mile Island, Furneaux Group, Bass Strait, *J. S.Whinray*, 9.ix.1973 (MEL); on *Banksia integrifolia*, North Point, Long Islet, Hogans Group, Bass Strait, *J. S. Whinray*, 26.xii.1973 (MEL); on coastal granite rocks, north point, Middle Pasco Island, Furneaux Group, Bass Strait, *J. S.Whinray 820*, 4.iv.1976 (MEL).
NEW ZEALAND. North Island. North Auckland: on coastal rocks in upper spray zone, Rangitoto Island, *H. H. Allan*, 19.viii.1933 (AK, CHR); on maritime rocks, Great Mercury Island, Coromandel Co., *B. W. Hayward*, v.1975 (AK); on maritime rocks, Kapiti Island, *B. W. Hayward*, iv.1982 (AK); on maritime rocks, west of Sulphur Bay, Motuhora (Whale) Island, Whakatane Co., *B. W. Hayward*, ii.1984 (AK); on maritime rocks, north-west of island, Rurima Island, Whakatane Co., *B. W. Hayward*, ii.1984 (AK); on maritime rocks, Boulder Bay, Motuhora (Whale) Island, Whakatane Co., *B.*

(AK); on maritime rocks, Boulder Bay, Motuhora (Whale) Island, Whakatane Co., *B. W. Hayward*, i.1986 (AK). South Island. On high maritime rocks, Sentinel Rock, Chetwode Islands, Marlborough Sounds, *B. W. Hayward*, iii.1984 (AK).

Diploicia canescens (Dicks.) Massal. *sens. str.*

Specimens Examined

AUSTRALIA. Victoria. On branches of *Avicennia marina*, Rhyll inlet, Phillip Island, *S. Platt*, 1.v.1982 (MEL).

Tasmania. On rock, Curtis Island, Bass Strait, *Rex Filson 12102*, 9.ii.1971 (MEL); on bushes, West Hill, West Sister Island, Furneaux Group, Bass Strait, *J. S. Whinray*, 14.xii.1966 (MEL); on *Beyeria leschenaultii*, Sharp Hill, Babel Island, Furneaux Group, Bass Strait, *J. S.Whinray*, 24.i.1967 (MEL); on *Leucopogon parviflorus*, dune at eastern end of southern beach, Cat Island, Furneaux Group, Bass Strait, *J. S. Whinray*, 7.ii.1967 (MEL); on dead wood of *Lycium ferocissimum*, East Kangaroo Island, Furneaux Group, Bass Strait, *J. S. Whinray*, 20.iv.1969 (MEL); on limestone outcrop, Wallibi Cove, Erith Island, Kents Group, Bass Strait, *J. S. Whinray*, 6.xii.1972 (MEL).

South Australia. On tree bark, Koonalda, Nullarbor Plain, *D. McVean 6654*, i.1966 (CBG).

Western Australia. On bark, Boxer Island, Recherche Archipelago, *J. H. Willis*, 9.xi.1950 (MEL).

CZECHOSLOVAKIA. Bohemia centr., Praha: on schist rocks, near Jenerálka, in Sárka valley, *J. Suza*, 1934 [Lichenes Bohemoslovakiae, Fasc. IX, No. 270] (MEL).

DENMARK. On rocks, Bornholm, Nexö, *P. J. Hellbom*, 1884 (MEL).

FEDERAL REPUBLIC OF GERMANY. Nordrhein-Westfalen: Welbergen, viii.1857 (MSTR); Herdecke, *H. Müller*, 16.ix.1859 (MSTR); Kr. Münster, Handorf, vii.1857 (MSTR); Bonn, *P. Dreesen* (MSTR); sine loco, *Beckhaus* (MSTR); sine loco, *Beckhaus*, viii.1859 (MSTR).

FRANCE. On *Quercus*, Loire-Atlantique, Plaine de Mazerolles, north of Nantes, *H. T. Lumbsch 4511a & E. Mietzsch*, 13.ix.1986 (ANUC).

NEW ZEALAND. North Island. On maritime rocks, South Cove, Lady Alice Island, Chicken Islands, *B. W. Hayward*, i.1982 (AK). South Island. Otago: on coastal rock, Black Head, Dunedin, *J. S. Thomson* (CHR).

UNITED STATES OF AMERICA. California. Orange County: on *Sambucus mexicana*, riparian woodland in canyon bottom, Irvine Ranch, Morro Canyon, *W. A. Weber & R. Santesson*, 14.iv.1966 [Lichenes Exsicc., Univ. of Colorado, No. 184] (MEL 25227).

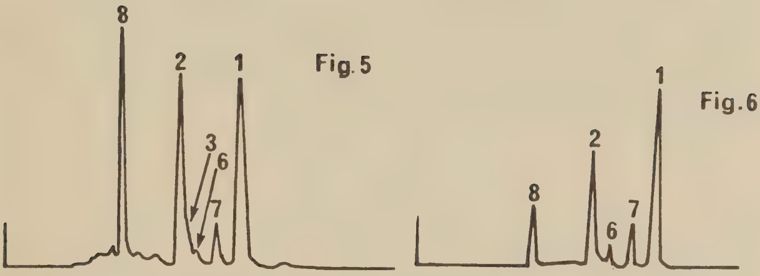
Diploicia subcanescens (Werner) Hafelln. & Poelt

The third taxon examined, namely *Diploicia subcanescens* (Werner) Hafelln. & Poelt, was readily distinguished chemically by the presence of gyrophoric acid (8) in addition to diploicin (1), dechlorodiploicin (2), dechloro-*O*-methyldiploicin (3), atranorin (6) and chloroatranorin (7) (Llimona, Werner, Lallemant & Boissiere 1976). H.p.l.c. traces of methanol extracts of this species are illustrated in Figures 5 and 6.

Specimens Examined

ITALY. Isola d'Elba, Lacona, Golfo di Lacona, *H. T. Lumbsch 102c,* 18.v.1981 (ANUC).

SPAIN. Prov. Almeria: Morrón de los Genoveses südlich San José am Cabo de Gata, *G. Follmann*, i.1982 [G. Follmann, Lichenes Exsiccati Selecti a Museo Historiae Naturalis Casselensi Editi, no. 362] (ANUC); Catalunya, Prov. Gerona: Sta. de Rosas, Perafita, Straße zwischen Perafita und Boufador, *N. Hladun, H. T. Lumbsch & A. Henssen 928l*, 24.v.1983 (ANUC).



Figures 5-6. H.p.l.c. traces of *D. subcanescens*. 5, *Follmann* in ANUC; 6, *N. Hladun, H. T. Lumbsch & A. Henssen D928l* in ANUC.

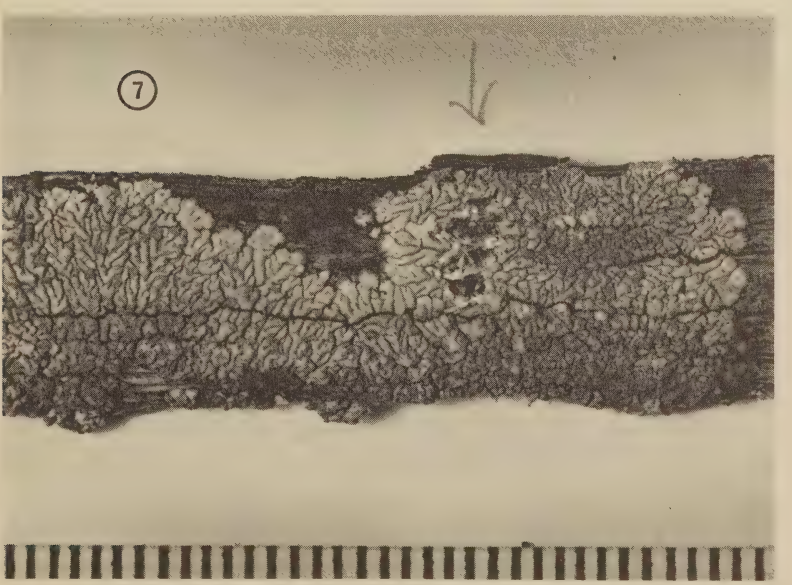


Figure 7. *Diploicia canescens* ssp. *australasica* (*J. A. Elix 4575* in ANUC). Scale in mm.

ACKNOWLEDGEMENTS

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MYCOTAXON

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ASCOMYCOTINA FROM ANTARCTICA

NEW SPECIES AND INTERESTING COLLECTIONS FROM DANCO COAST, ANTARCTIC PENINSULA.

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SUMMARY

Eight Ascomycetes have been found recently in the Antarctic Continent, growing on mosses, on herbs and soil. The new species here proposed are: Bryoscyphus aestivalis nov. sp., parasitic on Bryum dichotomum; Octospora ciervensis nov. sp., epiphytic on Bryum dichotomum; Psilocistella deschampsiae nov. sp., epiphytic on Deschampsia antarctica and Laetinaevia colobanthi nov. sp., on Colobanthus quitensis. A new variety is described: Cistella polytrichi (Vel.) Gamundí & Spinedi var. antarctica nov. var., on Polytrichastrum alpinum. Cistella grevillei (Berk.) Raschle on D. antarctica and C. quitensis is the first record for the Southern Hemisphere and Antarctica. Scutellinia kerguelensis (Berk.) Kuntze, of vast distribution in the Southern Continent, is now found in Antarctica. Thyronectria hyperantarctica (D. Hawksw.) D. Hawksw. & Spooner is also present in the area.

Our first contribution to the Ascomycetes from the Antarctic Continent was the discovery of the teleomorph of Sclerotium antarcticum Bomm. et Rousseau, which we described as Sclerotinia antarctica nov. sp. (Gamundí and Spinedi, Mycotaxon, 29: 81-89, 1987).

During the "Campaña Antártica Argentina de Verano" (1987-88) other Ascomycotina were found by one of us (H.A. Spinedi) in the same locality as the previous year, namely Danco Coast, Base Primavera (64º 10′S, 60º 57′W) indicated in the map in the mentioned paper, where some ecological remarks were made.

Fieldwork was concentrated in the humid areas, with small creeks formed by the melting snow whose crevices were covered by mosses, whereas the soil was also colonized by Colobanthus quitensis (Kunth) Bartl. (Caryophyllaceae) and Deschampsia antarctica Hook. (Gramineae). On these hosts, live some Discomycetes and Pyrenomycetes, sometimes saprophytically otherwise parasitic.

In this paper we describe these findings arranging them according with their habitats, for the orientation of scientists visiting the place.

I. MUSCICOLOUS SPECIES

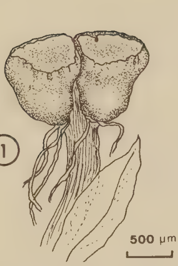
BRYOSCYPHUS AESTIVALIS nov. sp.

Figs. 1-10.

Apothecia parva (0.6-1.8 mm diam.), solitaria vel gregaria ad apicem caulis muscorum, turbinata vel discoidea, brevi pedicellata, stipes robustus conico-truncatus, cremea, sicca testacea, margine inflexa et undulata, glabra; hymenium planum vel convexum; extus pubescente, mucilaginosum. Asci octospori, cylindracei, parietibus tenuibus, foramen marginatus, iodo haud coerulescentes; 160-215 x 8-12 um. Paraphyses filiformes, simplices, multiseptatis, hyalinis, ad apicem 2.4-3 um. Ascosporae uniseriatae, hyalinae, tenues, fusoidea asymetricae, uni vel multiguttulatae, unicellularia demum rario 1-3 septatae; 15.4-26.4 x 5.3-9.6 um. Subhymenium 50-60 um cr., hyalinum, textura intricata compositum. Excipulum corticalis 410-600 um cr., in partibus centralis hyalinum, textura angularis non gelatinosum. Excipulum medullaris 190-290 um cr., textura intricata compacta compositum.
Holotypus: Antarctica, Peninsula Antarctica, Terra de Danco, Base Primavera, Leg. H. A. Spinedi, 7-II-1986, ad apicem caulum vivorum Bryii dichotomi Hedw., LPS 44356.

Apothecia small (0.6-1.8 mm diam.), growing solitary or in bunches at the apex of the stalk mosses, sometimes covered by leaves; turbinate to discoid with a robust conic-truncate stalk; totally creamy-white ("Cremeus" of Saccardo), drying dark honey to caramel ("testaceus"), not recovering the original colour by rehydratation; margin conspicuous (48-97 um thick in section), inflexed and ondulated; hymenium plane to convex; externally glabrous

Figs. 1-10. Bryoscyphus aestivalis nov. sp. 1. Two apothecia on the apex of stalk. 2. Schematic section of an apothecium. 3. Ascus and paraphyses. 4. Ascospores. 5. Upper part of dehiscent asci. 6. Section of margin and lateral of apothecia. 7. Cells of moss stalk containing hyphae. 8. Base of apothecium with cells containing coccoid Cyanophyta colonies. 9. Section of apothecia showing hymenium, subhymenium and medullary excipulum. 10. Section of apothecium showing medullary and cortical excipulum.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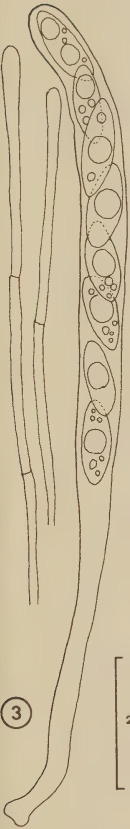
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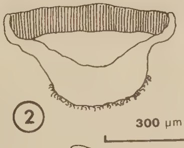
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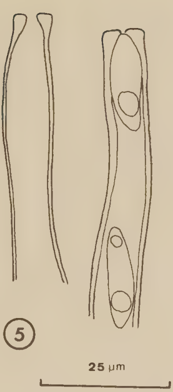
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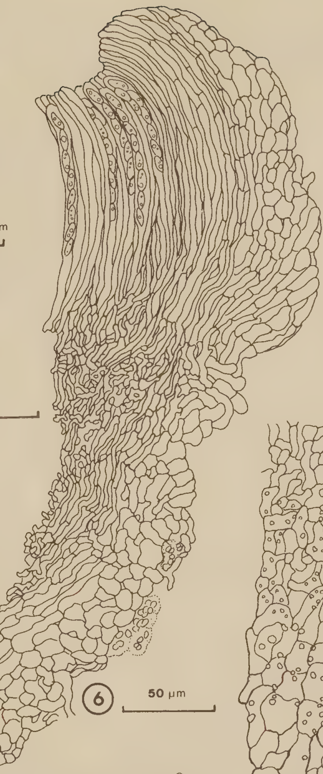
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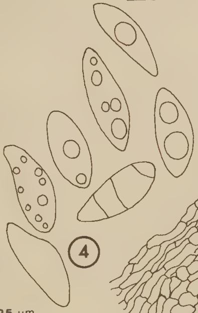
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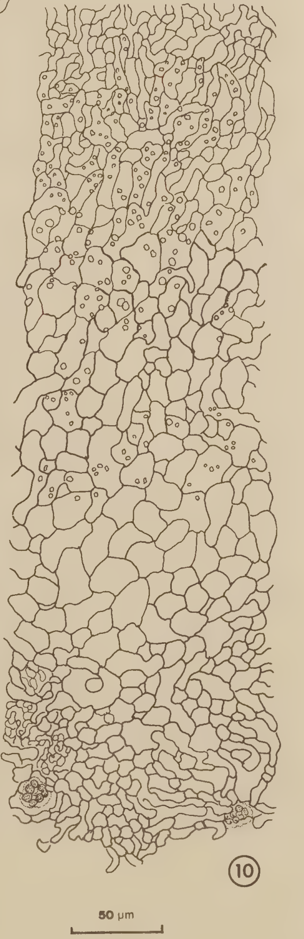
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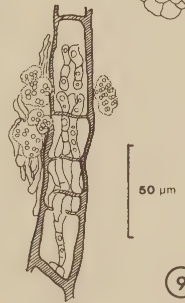
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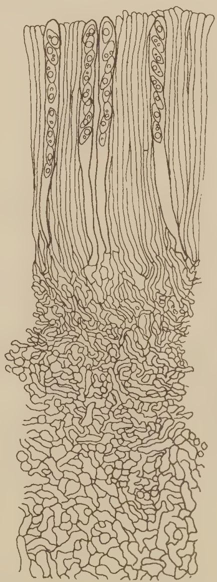
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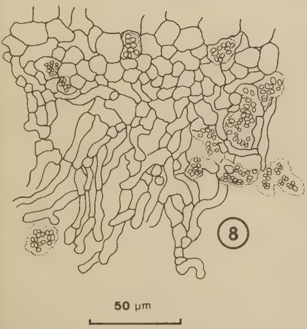
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at the margin, pubescent down the base, where colonies of coccoid Cyanophyta are fixed by mucilage. Asci 8 - spored, cylindrical, thin-walled, dehiscent through a marginate foramen, (J-), 160-215 x 8-12 um. Paraphyses simple, filiform, regulary septate, hyaline, the asci, 2.4-3 um diam. at the apex. Ascospores hyaline, smooth, asymmetrical fusoid, uniseriate, one-multiguttulate, unicellular and tardily septate (1-3 transverse septae); 15.4-26.4 x 5.3-9.6 um. Subhymenium 50-60 um thick, of loose textura intricata, hyaline, with hyphae staining pale blue with lactic blue; all the pseudotissue slightly mucilaginous. External excipulum thick (410-600 um) in the central part of apothecia, 145-340 um laterally, of textura angularis, hyaline, not gelatinous; individual cells 10-33 um diam. becoming smaller at the surface where they end in profusely interlocked hyphae. Medullary excipulum conical in shape, 190-290 um thick in the central part, laterally 97-170 um, hyaline, of tightly intermingled hyphae of 2.4-3.4 um, also staining pale blue with lactic blue. Margin formed by hyaline hyphae, at first arranged obliqually to the surface, then parallel and becoming thicker, composed of doliform or prismatic cells 2-3 um diam.. Host: on living Bryum dichotomum Hedw., growing acropetally on leaves and stalks. A longitudinal section of the stem shows abundant inter- and intracellular hyphae, formed by short and flexuose segments, profusely branched and containing guttules, passing through the transverse walls of the stalk cells following a longitudinal direction. Apical leaves also contain plenty of hyphae.

Holotypus: Antarctic Peninsula, Danco Coast, Base Primavera, leg. H. A. Spinedi, 7-II-1986 on Bryum dichotomum Hedw., LPS 44356.

Other material: Antarctic Peninsula, Caleta de los Dameros, leg. H. A. Spinedi, on Bryum dichotomum, beneath penguin's nests, 15-II-1988, LPS 44502.

Our Antarctic collections are well adapted to the description of Bryoscyphus Spooner (1984: 557) a Genus of bryophilous Helotiales seggregated from the extensive genus Hymenoscyphus. However, in our material the margin is not composed by hairs but rather by hyphae with a parallel orientation forming a neat inflexed margin. The ascus pore is J-, but Spooner (op. cit: loc. cit.) also includes Bryoscyphus dicrani (Ade & v. Hohnel) Spooner with J- asci, in his Genus. We believe that these minor differences cannot justify a segregation from Bryoscyphus.

Presence of acrocarpic bunches of apothecia at the apex of the living moss stalk and the intracellular hyphae suggest that the fungus is parasitic.

B. dicrani (Ade & v. Hohnel) Spooner (op. cit. 561) on Ceratodon purpurascens (Hedw.) Brid. from W. Germany is the closest species to the Antarctic collection, which differs in having pale brown apothecia, smaller asci, rhomboidal ascospores, paraphyses with golden pigment, excipulum dextrinoid at the base and different host (Dicranaceae). For these reasons we think that the antarctic species can be distinguished as a new one and we have named it aestivalis for developing in midsummer.

CISTELLA POLYTRICHI (Vel.) Gamundí & Spinedi nov. comb.
= Dasyscypha polytrichi Vel., Mon. Discomycetum Bohemiae, Pars. I: 241, Tab VIII, 6. 1934.

The minute apothecia and short hairs, indicate that the species fits better in the Genus Cistella Quél.

CISTELLA POLYTRICHI (Vel.) Gamundí & Spinedi var. ANTARCTICA nov. var. Figs. 20-22.

A typus recedit apothecia parva, pilus breves et flexuosus, basis stipes brunneis.

Holotypus: Antarctica, Peninsula Antarctica, Sinus Cierva, Base Primavera, leg. H.A. Spinedi, 3-II-1988, in Polytrichastrii alpinii (Hedw.) G. L. Smith, LPS 44504.

Apothecia minute (100-165 um diam.), gregarious or isolated, hairy; totally white except at the stipe base, which is pale brown; stipe cylindrical, short; drying ivory white; margin inflexed and covered by hairs longer than the laterals ones. Hymenium plane-concave, soft fleshy. Asci 8 - spored, clavate, with J+ pore and dextrinoid content when young, 32-40 x 3.6-4.5 um. Paraphyses robust, simple or bifurcate near the base, hyaline, not exceeding the asci, filiform, sometimes curved containing guttules; 1.3-1.8 um diam. Ascospores biseriate, hyaline, smooth, ellipsoidal with acute ends; 5.5-7.3 x 1.8-2.7 um. Hairs hyaline, flexuose, obtuse at the apex, with granules irregularly incrusted on the walls, apparent only when mounted in water, dissolving in KOH or lactic blue; pluriseptate, the marginal longer (27-47 x 2.7-3.6 um); laterals hairs shorter, bulbous and curved (15-22 x 2.7-3.6 um). Excipulum of textura prismatica, with hyaline cells. Stipe cylindrical (77 x 30 um), not hairy, light brown at the base, formed by hyphae with cell walls incrusted with brown granules. Host: on dead leaves of Polytrichastrum alpinum (Hedw.) G.L. Smith.

Holotypus: Antarctic Peninsula, Cierva Cove, Base Primavera, leg. H.A. Spinedi, 3-II-1988, LPS 44504 on Polytrichastrum alpinum (Hedw.) G.L. Smith.

Other material: same locality, same host, leg. H.A. Spinedi, 5-II-1987, LPS 44505.

The differences with the material of Dasyscypha polytrichi Vel. (1934: 247, tab. VIII, fig. 8) are stated in the latin diagnosis. We believe these minor differences only deserve the category of "varietas". The fungi in question belongs to the Helotiales, Hyaloscyphaceae.

OCTOSPORA CIERVENSIS nov. sp.

Figs. 11-19

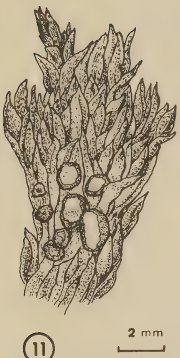
Apothecia carnosa-molle, minuta (0.5-1 mm diam.) sessilia, hemisphaerica, ad axilia foliorum adnascens: hymenium luteus, papillosus, planum; margine erectus et obtuse crenatus; extus glabrus, pallidiore. Asci octospori, raro 4-6 spori, cylindraceis, iodo haud coerulescente, 200-270 x 13-17 um. Paraphyses simplices vel bifurcatis, rectis vel curvatis; guttulae aurantiaciis impletis, 4-6 um cr.. Ascosporae uniseriatae, ovoidea vel curta ellipsoidea, uniguttulatae; episporio verruculoso, 13.2-18.6 x 10.8-12 um. Subhymenium 50-60 um cr., textura intricata compositum. Excipulum 300-400 um cr., textura angularis, cellulis centralis 5-17 um, ad basim hyphoidea et ad marginem hyphae erectae, lutea, parallelis dispositis.

Holotypus: Antarctica, Peninsula Antarctica, Terra de Danco, Sinus Cierva, Base Primavera, leg. H.A. Spinedi, 7-II-1986, ad axilia foliarum adnascens Bryii dichotomi Hedw. LPS 44357.

Apothecia minute (0.5-1 mm diam.), situated in the axil of the leaves, sessile, hemispheric; hymenium egg-yellow ("luteus"), plane, papillose; margin elevated, crenate; externally glabrous, paler yellow than the hymenium, soft fleshy. Asci 8 spored, cylindrical, (J-), with a rounded apex, longer than the paraphyses, 200-270 x 13-17 um; occasionally with 4-6 spores. Paraphyses simple or bifurcate in the upper portion straight or curved, containing orange guttules, 4-6 um diam. at the apex. Ascospores uniseriate, short ellipsoidal to ovoid (l: w = 1.4 : 1) containing usually one refringent guttule; epispore verruculose, verrucae irregular and densely arranged, 13.2-18.6 x 10.8-12 um. Subhymenium 50-60 um thick, of textura intricata where ascogenous hyphae stained deeply with lactic blue, intermingled with hyaline medullary hyphae. Excipulum 300-400 um thick, of textura angularis; cells 5-17 um diam. in the central portion, becoming smaller at the surface, at the base ending in robust hyphae, 4.8-7.2 um diam., hyaline, attached to the substratum. Margin elevated, constructed by vertically parallel hyphae, pale yellow, with swollen or rounded apex, 4.8-7.2 um diam. Host: at the axil of leaves and stem of Bryum dichotomum Hedw.

Holotypus: Antarctic Peninsula, Danco Coast, Cierva Cove, Base Primavera, leg. H.A. Spinedi, 7-II-1986, LPS 44357. Other material: Idem, 15-II-1988, LPS 44501.

Figs. 11-19. Octospora ciervensis nov. sp. 11. Bunch of Bryum dichotomum Hedw. with several apothecia. 12. Apothecium. 13. Ascospores. 14. Diagrammatic section of a apothecium. 15. Paraphyses. 16. Ascus with ascospores. 17. Longitudinal section of an apothecium showing: part of the hymenium, subhymenium and excipulum. 18. Margin. 19. Detail of the margin in superficial view.



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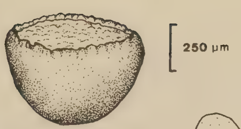

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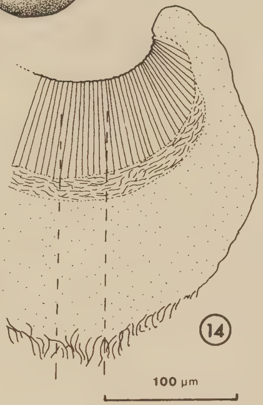

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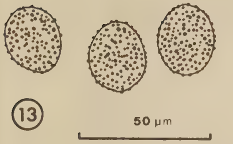

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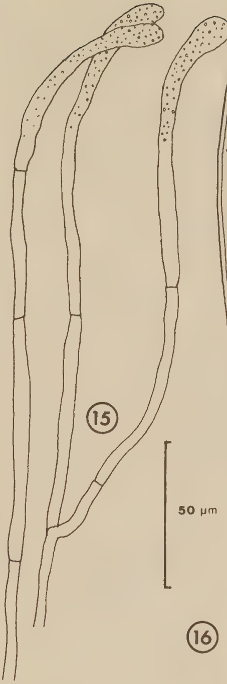

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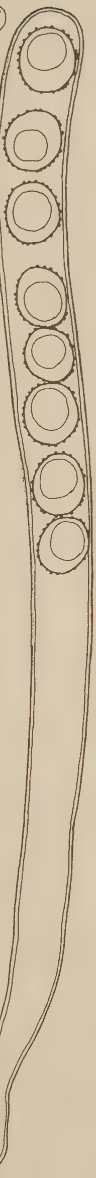

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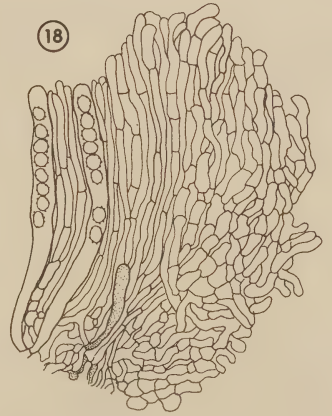

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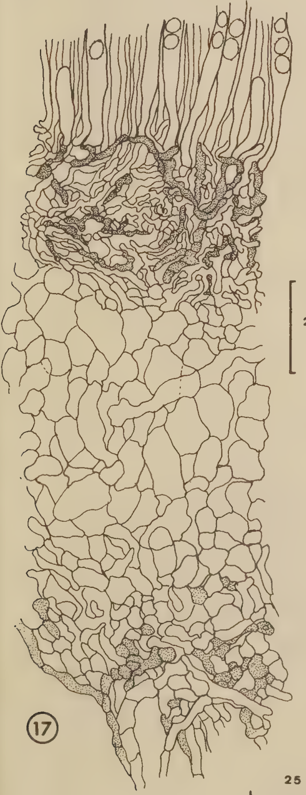

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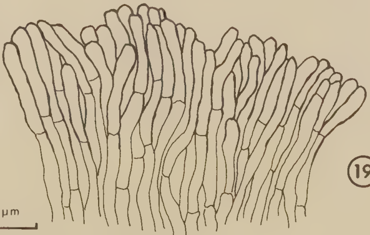

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The closest species to our antarctic collection is *Peziza wrightii* Berk. & Curt. We examined the type specimen, kept at Farlow Herbarium (FH), thanks to the kindness of Dr. D. Pfister, (Coll. Wright Nº 3139, between mosses, Texas, U.S.A.) and found the following different features: 1) margin is visibly dentate; 2) ascospores are larger (17.3-23 x 14-20 um) with rounded, gross verrucae 3-3.6 um diam.; 4) straight paraphyses; 5) excipulum less developed.

As Khare (1976: 964-965, figs. 12-22) stated that *Octospora wrightii* (Berk. & Curt.) Moravéc (1969: 222-228, fig. 31) was wrongly identified, but differs in a few characters, he named this species *Octospora moraveci* Khare (PR 77036). We consulted both descriptions and also found the followings differences: no elevated margin, ascospores with verrucae 0.5-1.5 um, irregular in size, excipulum 70-150 um thick and straight paraphyses. This description does not agree with the antarctic material, when both are compared. If there is any similarity, it is between *O. wrightii* and *O. moraveci*, but both are different from *O. ciervensis*.

The differences between *Lamprospora* De Not. and *Octospora* Hedw. were established by Rifai (1968: 191) and are subtile, the features that characterize the first genus being the globose ascospores with strong cyanophylic ornamentation and straight paraphyses whereas *Octospora* Hedw. has curved paraphyses and elliptical to oval ascospores with smooth or finely ornamented epispore.

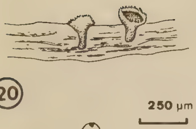
We also compared our antarctic sample with *Lamprospora cashiae* Gamundí (1975: 122, pl. XLI) found in Magallanes and Tierra del Fuego, but spores in this species are spherical, paraphyses straight and the margin neatly dentate. In view of this analysis we propose as new *Octospora ciervensis*, the epithet derived from the geographic location.

THYRONECTRIA HYPERANTARCTICA (D. Hawksw.) D. Hawksw. & Spooner, Kew Bull. 32(3): 519. 1980.

Figs. 27-29.

This species has been described twice (Hawksworth, 1973; Pegler, Spooner and Lewis Smith, 1980) for the An-

Figs. 20-29. *Cistella polytrichi* (Vel.) Gamundí & Spinedi var. *antarctica* nov. var. 20. Apothecia. 21. Ascus, paraphyses and ascospores. 22. Detail of the margin with hairs. *Cistella grevillei* (Berk.) Raschle. 23. Apothecia and hairs. 24. Hairs of the type of *Peziza grevillei* Berk. (K). 25. Superficial view of margin. 26. Ascospores. *Thyronectria hyperantarctica* (D. Hawksw.) D. Hawksw. & Spooner. 27. Habit. 28. Diagrammatic section of a perithecium, A: Detail of a section at the ostiole; B: Detail of section of the wall. 29. Asci and ascospores.



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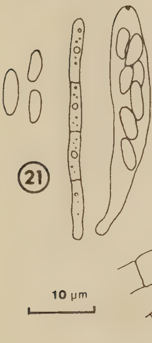

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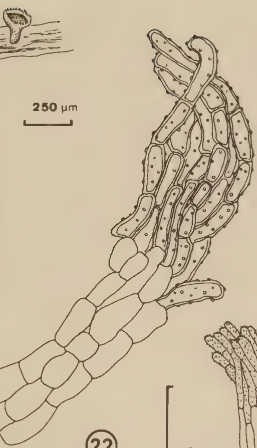

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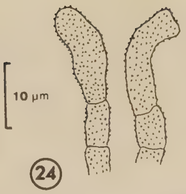

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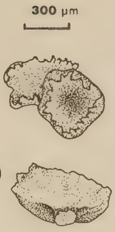

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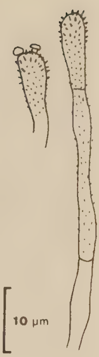

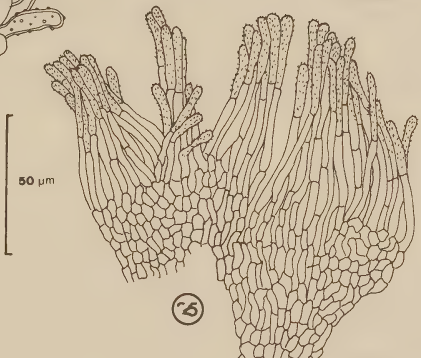

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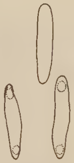

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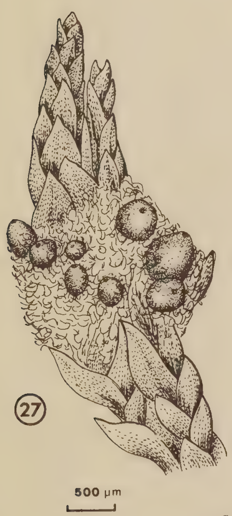

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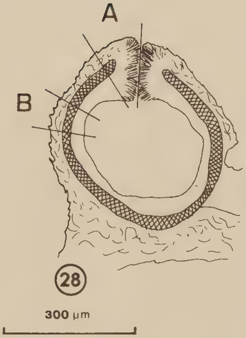

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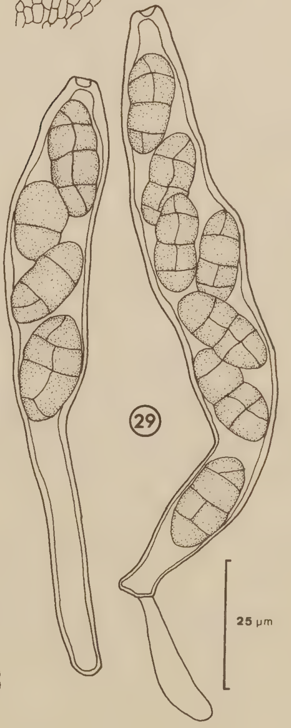

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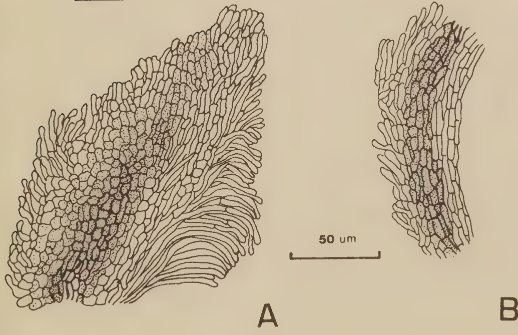


tarctic area: South Orkney, Signy Is. on leaves of Tortula excelsa and Bryum algens and Antarctic Peninsula, Argentine Is. and Galíndez Is. on Bryum algens and Brachytecium austrosalebrosum; is tipically parasitic. The first author mentioned it causing moribund rings in bryophyte colonies. Our collections coïncide with the descriptions given: one of us (H.A.S.) observed also brownish rings in the moss carpet. But this time the host was Bryum dichotomum Hedw. and the locality Danco Coast, Base Primavera, leg. H.A. Spinedi, II-1986-1987, LPS 44385, 44359, 44360 and 44361. Figs. 27-29 illustrate the habit, wall construction of the perithecium and a few ascospores, measuring 30-40.8 x 12-18 um.

II. HERBICOLOUS SPECIES

CISTELLA GREVILLEI (Berk.) Raschle, Nova Hedwigia, 30: 659. 1978.

Figs. 23-26

We examined the type specimen of Peziza grevillei Berk., Edinburgh, leg. Greville, Sept. (K) on Umbelliferous stem, and found it coïncident with our antarctic collection. They differ in a few minor details: hairs (see fig. 24) are thicker and with the ornamentation embracing 1st., 2d. and 3d. apical cells in the type; in our collection they are dense and a bit more spinulose. We also add drawings of the margin where the fascicles of hyaline hairs can be seen (Fig. 25). The ascospores are allantoid, hyaline, 8.2-12.7 x 1.8-2.7 um not illustrated in previous papers (Dennis, 1949 : 32 and Raschle, 1978: 660).

Host: on Colobanthus quitensis alive, but apothecia growing at the base of moribund leaves and on dead fruits. Also on Deschampsia antarctica. Material seen: Typus (K); Peninsula Antarctica, Danco Coast, Base Primavera, leg. H.A. Spinedi, 10-II-1987, LPS 44500, 44503.

We accept the name Cistella Quél. (1886) as "nomen conservandum" (Cannon, Hawksworth and Sherwood-Pike, 1985), synonym of Clavidisculum Kirscht. fide Raitviir (1970) with C. dentata (Pers.: Fr.) Quél. as type species.

Cistella grevillei has a wide geographical distribution: Great Britain, Switzerland, Austria, URSS (Tienchan W), Hungary (fide Raschle 1978). Peninsula Antarctica is the most extreme latitute (64º S).

C. grevillei grows in a variety of hosts that include Mono- and Dicotyledons. We add here two new hosts.

PSILOCISTELLA DESCHAMPSIAE nov. sp.

Figs. 30-33

Apothecia carnosa, minuta (320-480 um diam.) superfi-

pilosa. Margine et externe pili albidis; hymenium planum vel concavum. Asci octospori, clavatis, ad basim bifurcatis, parietibus crassis, poro iodo coerulescente, 25-36 x 3.6-4.5 um. Paraphyses clavatae, robustae, hyalinae ad basim bifurcatae ad apicem 1.4-1.8 um. Excipulum corticalis textura prismatica vel porrecta, ad superficiem pilosis; pili hyalinis, clavatis, adpressis, 0-1 septatis, 12-13.6 x 3-4.5 um. Excipulum medullaris textura porrecta. Margo cum pili hyalinis, fasciculatis, clavatis, glabro-tunicatis, 1-4 septatis, 18-45 x 3.3-3.6 um. Stipite brevis, textura porrecta, externe textura globulosa. Hospitis: Deschampsia antarctica Desv..

Holotypus: Antarctica, Peninsula Antarctica, Sinus Cierva, Base Primavera, leg. H.A. Spinedi, 5-II-1987, ad basim foliorum moribundorum Deschampsiae antarcticae Desv. LPS 44506.

Apothecia minute (320-480 um diam.) shortly stipitate, completely white, drying salmon colour, externally hairy; hymenium plane to concave; margin with white hairs, shorter and adpressed in the flanks of the apothecium; soft fleshy. Asci 8 - spored, claviform, bifurcate at the base, with thick walls, ascus pore J+, 25-36 x 3.6-4.5 um. Paraphyses claviform, robust, hyaline, bifurcated near the base, with thick walls, not excceding the asci; 1.4-1.8 um diam. at the apex. Ascospores 2- seriate, fusoid asymmetrical, smooth, sometimes with guttules, (5.5) 6.3-9.1 x 1-1.8 um, unicellular, becoming 2-3 celled before germination. External excipulum of textura prismatica to porrecta, with hyphae oblique to the apothecial surface at the flanks, ending in smooth, hyaline, clavate and adpressed, 0-1 septate hairs, 12-13.6 x 3-4.5 um. Medullary excipulum of textura porrecta, the hyphae parallel to the hymenial surface. Margin formed by fascicles of adpressed, 1-4 septate, smooth walled, hyaline hairs, clavate at the apex, 18-45 x 2.3-3.6 um. Stipe very short, composed of a medulla of textura porrecta and an external excipulum of textura globulosa. Host: growing at the base of moribund leaves of Deschampsia antarctica. Holotypus: Antarctic Peninsula, Cierva Cove, Base Primavera, leg. H.A. Spinedi, 5-II-1987, LPS 44506. Other material: same place and collector, LPS 44507.

Psilocistella Svrcek (1977: 196) is a genus of Hyaloscyphaceae (Helotiales) seggregated from Cistella Quél. emend. Nannfeldt (1932) to accomodate minute hairy species with smooth, obtuse, thin-walled hairs, filiform paraphyses not exceeding the asci. It differs from Psilachnum v. Höhn. which has lanceolate paraphyses longer than the asci. Type species of Psilocistella Svr. is Ps. obsoleta Svr., growing on wood of Fagus sylvatica. From the 8 species registered up to date in Psilocistella, the closest species to the Antarctic species is Ps. fonticola Svr. (1983: 66) on submerged stems of Typha latifolia in Czechoslovakia, but differs essentially in the asci, that are 4- spored.

LAETINAEVIA COLOBANTHI nov. sp.

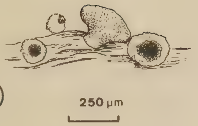
Figs. 34-39.

Apothecia carnosa-gelatinosa, minuta (80-155 um diam.) subepidermia deinde erumpentia, denique superficialia, sejuncta vel gregaria, sessilia, discoidea vel ovalia, totaliter lutea; hymenium planum vel convexum, margine crasso. Asci octospori, clavati, iodo coerulescente inconstante, 68-90 x 12-13.6 um. Paraphyses hyalinae, superne ramosae, curvatae, filiformia, 0.9-1.35 um diam. Ascosporae biseriatae, hyalinae, laevia, bicellularia, subinde biseptatae, 13.6-19 x 4.5-6.4 um (x = 5.45). Excipulum corticale exiguum, textura globulosis vel angularis ex cellulis hyalinis compositum, 4.6-9 um (13.8) um diam. Excipulum medullare textura intricata.

Holotypus: Antarctica, Peninsula Antarctica, Terra de Danco, Sinus Cierva, Base Primavera, Leg. H.A. Spinedi, 10-II-1987, in caules, folia et fructus emortuis Colobanthi quitensi Ktze. LPS 44508.

Apothecia subepidermal, then erumpent, superficial at maturity, minute, (80-155 um diam.), isolated or gregarious, sessile, disk-like, with circular or oval contour; hymenium plane or slightly convex; totally yellow, drying orange; margin thick; fleshy gelatinous. Asci 8 - spored, clavate, with a conical protrusion at the apex, where the wall is thicker, J+, but with insconstant reaction, 68-90 x 12-13.6 um. Paraphyses hyaline, profusely branched at the upper part, shorter than the asci, curved, filiform or thicker at the apex, 0.9-1.35 um. Ascospores irregularly 2 - seriate, hyaline, smooth, 2 - cellular, with submedian septum, 13-6.9 x 4.5-6.4 (x = 5.45). External excipulum poorly developed, at the margin formed by parallel hyphae slightly thicker than the paraphyses (2.3-3.4 um diam); laterally of textura globulosa to angularis, composed by small cells, hyaline, 4.6-9 um diam.; at the base with the same textura but larger cells 11.5-13.8 um diam. Medullary excipulum obconic "in toto", of textura intricata. Subhymenium with ascogenous hyphae vertically arranged and deeply stained with lactic blue. Host: on stems, leaves and capsules of the previous year of Colobanthus quitensis. (Caryophyllaceae). Holotypus: Antarctic Peninsula, Danco Coast, Cierva Cove, Base Primavera, leg. H.A. Spinedi, 10-II-1987, LPS 44508.

Figs. 30-39. Psilocistella deschampsiae nov.sp. 30. Apothecia. 31. Section of apothecium showing hymenium and excipulum. 32. Asci, paraphyses and ascospores. 33. Hairs. Laetinaevia colobanthi nov. sp. 34. Habit. 35. Diagrammatic section of apothecium. 36. Ascus and paraphyses. 37. Detail of a section of an apothecium. 38. Ascospores. 39. Apex of the ascus, with ascus pore J+.



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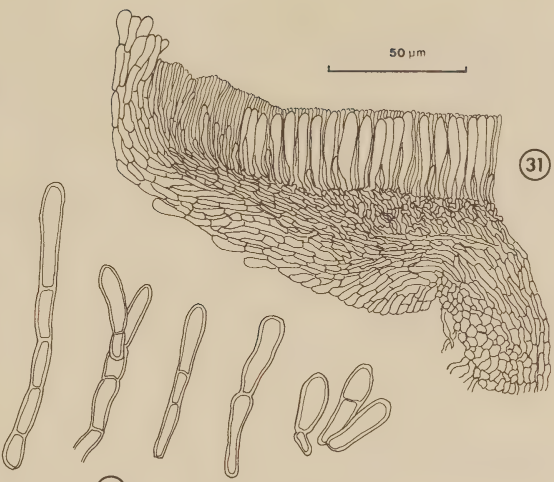

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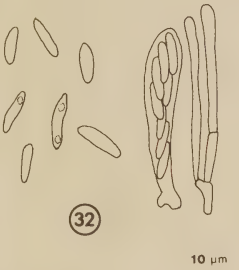

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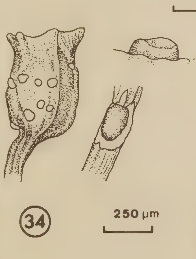

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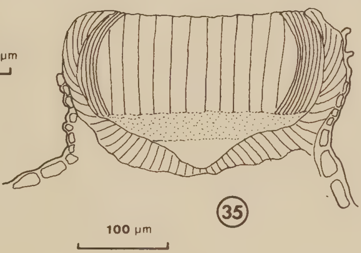

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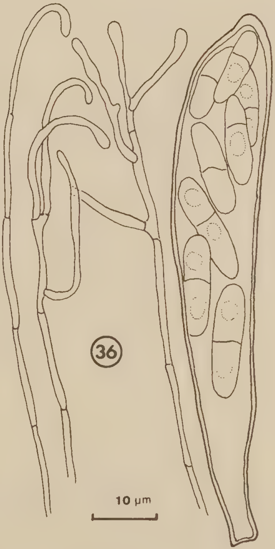

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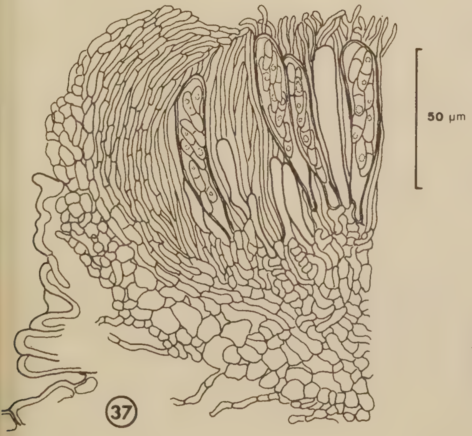

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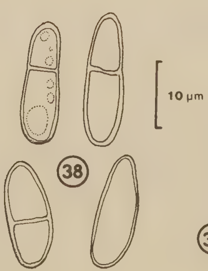

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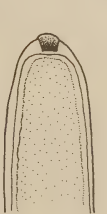

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Laetinaevia Nannfeldt (1932) belongs to the Family Dermateaceae Subfam. Naevioideae Nannf. and is characterized by subepidermal, erumpent apothecia of bright colour, the marginal tissue formed by thin-walled, hyaline or pale brown cells, disc circular or oval and ascus pore J+ or J-. The antarctic material agrees well with this generic description. The genus has been revised by Hein (1976) and our species does not agree totally with any of the species described by him. One species reminiscent of ours is L. erythrostigma (Rehm) Nannf. ex Hein (1976) on Cerastium and Minuarta, but this species is bright red with brown margin and broader ascospores. Calloria erythrostigmoidea Rehm (1896: 464) is somewhat similar to the Antarctic material, but Heim (op. cit.: 43) believes that is a synonym of L. erythrostigma Nannf.

III. TERRICOLOUS SPECIES

SCUTELLINIA KERGUELENSIS (Berk.) Kuntze Rev. Gen. Pl. II: 869. 1891.

Habitat: on soil between mosses. Locality: Antarctic Peninsula, Danco Coast, Cierva Cove, Base Primavera, leg. H.A. Spinedi, 2-II-1987, LPS 44335.

Geographical distribution: Kerguelen Is. (Berkeley, 1877, 1879); Henning (1906); South Georgias (Pegler et al., 1980); Malvinas Is. (Cotton, 1915); Argentina: Mendoza (Gamundí, 1960), Tierra del Fuego (Ibid., 1975); Australia, Tasmania and New Zealand (Rifai, 1968); Madagascar (Le Gal, 1953); Tunisia (Le Gal, 1966); Sweden, Lappmark (Le Gal, 1966); Czechoslovakia (Le Gal, 1966); Cape Hoorn (Le Gal, 1966).

This is the first time that the species is recorded for the Antarctic Continent.

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We thank Drs. J.E. Wright & R.P. Korf for their criticism on reading the manuscript, Prof. Celina Matteri for identification of the mosses and N.M. Malacalza for inking the drawings.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. LX.
CORYNESPORA MATUSZAKII, AN UNDESCRIBED SPECIES WITH NARROW, CYLINDRICAL, CATENATE CONIDIA AND HIGHLY-REDUCED CONIDIAL CELL LUMINA.

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ABSTRACT

Corynespora matuszakii Morgan-Jones, a new species, collected on decaying herbaceous stems (probably Asteraceae) in the Cornell Wildflower Garden, Ithaca, New York, is described and illustrated. The taxon is distinguished by its catenate, long, relatively narrow, cylindrical, cigar-shaped conidia whose cell lumina are greatly reduced or occluded. It is compared with *Corynespora viticis* Guo, which it most closely resembles.

INTRODUCTION

The genus *Corynespora* Güssow, first described in 1906, remained monotypic for over four decades until Wei (1950), Ellis (1957, 1960, 1961a, 1961b, 1963a, 1963b) and Hughes (1958) took it up for many taxa previously described in such genera as *Helminthosporium* Link and *Podosporium* Schweinitz, or added new species to it. By 1971, when M.B. Ellis published his book 'Dematiaceous Hyphomycetes', a little over twenty additional species had been accommodated in the genus. During the past decade and a half, its growth has proceeded unabated with, to my knowledge, twenty more taxa being added, most as new species, bringing the total number to date to forty-four. Among recent publications in which more than one species are described, are those of Ellis (1976), Yen and Lim (1980), Guo (1984) and Holubovā-Jechovā and Castañeda (1986). Although now a sizable genus, *Corynespora* is, by and large, relatively homogenous. It contains, however, one or two discordant elements and it seems that at least some recently described species are only marginally distinct from others previously known. *Corynespora heterospora* Yen and *C. longispora* Sarbhoy & Saikia are, for example, very close to *C. cassiicola* (Berk. & Curt.) Wei, the type species of the genus. The former, described from *Manihot utillissima* Pohl [*M. esculenta* Crantz] in Malaysia, bears a close morphological resemblance to *C. cassiicola*. Yen (1980) stated that *C. heterospora* is characterized by conidia of two different types [shapes], obclavate and cylindrical, but *C. cassiicola* is also known to be variable in this regard (Ellis, 1957). Furthermore, *C. cassiicola* has been recorded on *Manihot esculenta*. *Corynespora longispora* was said (Saikia and Sarbhoy, 1980) to differ from *C. cassiicola* in having conidia that are, to quote, "predominantly narrower and longer", and in possessing stromata. The length reported is,

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however, well within the range of *C. cassiicola* (see Ellis, 1957) but the conidia are more slender. The largely substrate-based species *C. eranthemi* Yen & Lim, *C. hemigraphidis* Yen & Lim, and *C. ruelliae* Yen and Lim (Yen and Lim, 1980) do not appear to be morphologically very distinct from one another. When Holubová-Jechová and Castañeda Ruiz (1986) transferred *Teratosperma litchii* Matsushima to the genus [as *C. litchii* (Matsushima) Hol.-Jech. & Castañeda], and added a new species, *C. calophylli* Hol.-Jech. & Castañeda, which is morphologically similar to it, the limits of the genus were extended unduly. Although their conidiophores resemble those of species of *Corynespora*, the conidia of these two species are very different from those typical of the genus. Holubová-Jechová and Castañeda (1986) correctly pointed out that conidiogenesis in *Teratosperma* Sydow, being monoblastic, is entirely different from that seen in *C. litchii* and the conidiophores are different in being annellidic. They were therefore justified in removing it from that genus. It is doubtful, however, that the two taxa *C. litchii* and *C. calophylli* are satisfactorily classified in *Corynespora* because of their thin-walled, verruculose, morphologically-unique, euseptate conidia. In the case of *C. litchii*, the possession of a single, subulate, downwardly-directed conidial appendage is an additional, but important, distinction. In essence, these two species probably represent a hitherto undescribed genus. *Corynespora aterrima* (Berk. & Curt.) M.B. Ellis is another somewhat atypical species in that it has euseptate, verruculose conidia and conidiophores that are less well developed than is normal in the genus.

During the spring of 1988, an interesting collection of a *Corynespora* was made on decaying herbaceous stems in the Cornell Wildflower Garden by John Matuszak and forwarded to the author by Richard P. Korf for study and, if necessary, description. The fungus had been isolated in pure culture. It produces striking, long, catenate, cigar-shaped conidia whose lumen is largely occluded or eventually, when mature, totally obliterated. Following examination and comparison with previously known species, it has been determined that the collection represents a novel taxon which is named, described and illustrated herein.

TAXONOMIC PART

Corynespora matuszakii sp. nov. (Figure 1)

Coloniae in agaro decocto tuberorum post 7 dies 25C ad 48 mm diametro, pallide griseae vel griseae, lanosae; reverso atro. Mycelium ex hyphis ramosis, septatis, laevis vel interdum verruculosis, plerumque inflatis, subhyalinis vel pallide brunneis, 2-4 µm crassis compositum. Stromata nulla vel incohata. Conidiophora macronemata, mononemata, ex apice lateribusque hypharum oriunda, erecta vel ascendentia, recta vel leniter flexuosa, simplica, brunnea, septata, cylindrica vel clavata, levia, interdum usque ad 2 proliferationes successivas cylindricas elongascentia, usque ad 230 µm longa, 6-8 µm crassa. Cellulae conidiogenae monotreticae, determinatae, terminales, in conidiophoris integratae. Conidia singula vel 2-5 in catenulam singulam conjuncta, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, recta vel leniter curvata, cylindrica vel obclavata, sicca, laevia, straminea vel medio brunnea, parietibus crassis, cellulis singularibus luminibus deminutis, 2-10 distoseptata, 56-260 µm longa, 10-12.5 µm crassa, basi truncata 6-7 µm lata.

In caulis emortuis, near Fall Creek, N.W. corner of Cornell Wildflower Garden, Ithaca, New York, March 26, 1988, J. Matuszak, CUP 61906, holotypus.

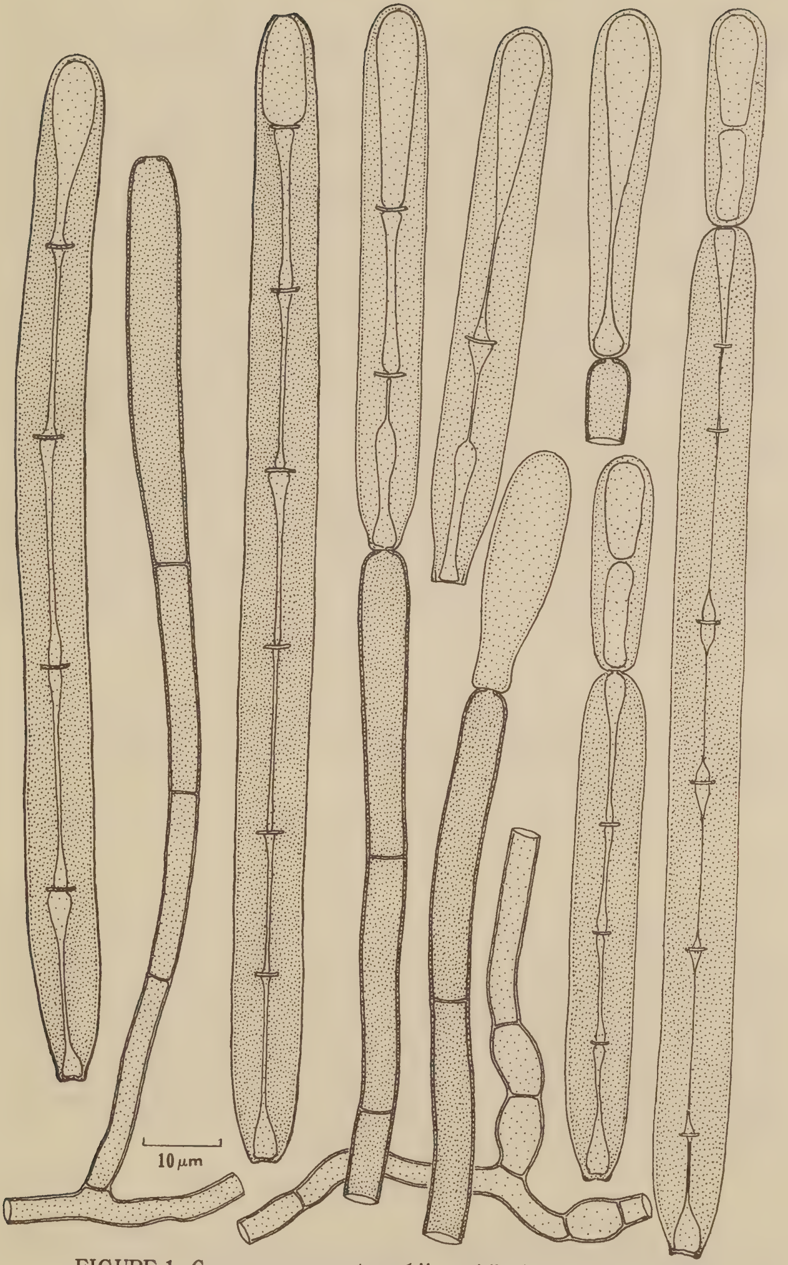

FIGURE 1. *Corynespora matuszakii*; conidiophores and conidia.

Colonies on potato dextrose agar [Difco] attaining a diameter of 47 mm at 20C after 7 days, 48 mm at 25C and 15 mm at 30C, at first whitish to pale gray, becoming dove gray to charcoal gray; after 7 days with a white, 5-8 µm wide margin, zonate, lanose, somewhat felted after 21 days and often uniformly dark. Reverse dark gray to blackish. Mycelium composed of branched, septate, smooth or sometimes verruculose, subhyaline to pale brown, 3-4 µm wide hyphae individual cells of which sometimes become inflated up to 6.5 µm wide. Hyphae from which conidiophores originate often abundantly branched, undulate and with scattered, swollen, barrel-shaped cells. Stromata none or very rudimentary. Conidiophores macronematous, mononematous, arising singly, terminally or mostly laterally on the hyphae, erect or ascending, straight or slightly flexuous, simple, brown, septate, cylindrical or narrowly clavate, smooth, up to 230 µm long, 6-8 µm wide, with occasionally one, or very rarely two, terminal, cylindrical proliferations. Conidiogenous cells monotretic, usually determinate (except where proliferation occurs), terminal, incorporated in the conidiophores or conidia. Conidia formed singly or, more frequently, in unbranched chains of 2-5 through a pore at the apex of the conidiophore or successive conidia, usually straight or very slightly curved, cylindrical or, sometimes, narrowly obclavate and gradually attenuated toward the apex, dry, smooth, pale brown to straw-colored or mid brown, thick-walled, 2-10 distoseptate, with distance between septa varying from 5 to 38 µm (septa toward the apex frequently much closer than elsewhere), individual cells often, particularly when mature, with greatly reduced or obliterated lumina, 56-260 µm long, 10-12.5 µm wide, 6-7 µm wide at the truncate base, sometimes tapering to 5-6 µm wide at the apex. When fertile and giving rise to a conidium terminally, conidia with a flat, 3.5-4.5 µm wide, truncate extreme apex rather than obtuse as where solitary. Primary conidia generally longer than those elsewhere in a chain.

On herbaceous stems (? Asteraceae); North America.

Collection examined: on decaying herbaceous stems (probably Asteraceae), small meadow near Fall Creek in N.W. corner of Cornell Wildflower Garden, Ithaca, New York, U.S.A., March 26, 1988, J. Matuszak, CUP 61906, AUA, type. Culture derived from this collection.

Corynespora matuszakii is named for Mr. John Matuszak, its collector.

DISCUSSION

Corynespora matuszakii is, among known species of *Corynespora*, most closely similar to *C. viticis*. It shares in common with that species long, relatively narrow, catenate conidia with reduced cell lumina. The conidia of *C. viticis* are, however, consistently narrower (6.3-8.8 um; fide Guo, 1984) than those of *C. matuszakii*, attain much greater length, and are often appreciably more curved. Guo (1984) noted that *C. viticis* resembles *C. citricola* M.B. Ellis, but differs from it in having longer conidiophores and conidia, inconspicuous pseudosepta and in lacking stromata. Rudimentary stromata composed of globose, brown cells, were, however, noted to occur and illustrated in Guo's treatment of *C. viticis*. Conidia of *C. citricola* are, like those of *C. viticis*, narrower than those of *C. matuszakii* (see Ellis, 1957).

ACKNOWLEDGMENT

I thank Dr. Richard P. Korf, Cornell University, for affording me the opportunity to study and describe *C. matuszakii* and for prepublication review of

this article.

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BOOK REVIEWS

by

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LES AMANITES EUROPEENNES, by GARCIN, R. 332 pp., 17 x 22 cm, paperback, 1984. Fédération mycologique Daufiné-Savoie, Marlioz, F-74270 Frangy, France.

As a subtitle, the author proposes "Exposé réunissant les différentes observations des mycologues: Clé monographique, Historique et fractionnement du genre *Amanita*, Description des espèces validées." He limits the scope of this publication to the European species. It is a compilation of fungal names used under the genus *Amanita* and of opinions expressed by past and recent mycologists about them. One might hope to find here the results of a long and arid investigation, but the data have unfortunately not acquired the technical precision or presentation which could help scientific investigation. The hundreds of compiled names are without full bibliographic reference, although a list of consulted titles is provided. The names are listed alphabetically as they appeared in literature before the 1983 International Code of Botanical Nomenclature, thus with Fries 1821 as starting point for valid publications and with obsolete author citations. The numerous opinions reported from authors are merely taxonomic and demonstrate great variation; they are not arranged based on type specimen examination. No type specimens of names are cited, nor generic type species mentioned. 112 taxa (species, varieties and formae) are accepted and a key is provided for their recognition amongst the 9 sections of the genus distributed into 2 subgenera, *Amanita* and *Lepidella.*

FUNGI AND FOOD SPOILAGE, by PITT, J.I. and A.D. HOCKING, xi + 413 pp., 141 fig., 15 x 23 cm, cloth hardcover, Food Science and Technology, A series of Monographs, 1985. Academic Press, Centrecourt, 25-27 Paul Street North, North Ryde, N.S.W. 2113 Australia. US $59.- ISBN 0 12 557730 3.

This excellent and much needed book deals with food mycology, particularly the identification of fungi in food, their specificity to food as an habitat and their action on foods, in the context of spoilage, not production. At first, the fungi are considered in their ecology, in regard to water activity, hydrogen ion concentration, temperature, gas tension, nutrients, specific solute effects and food preservatives. After telling within a few pages what the name(s) of a fungus mean and what identifying fungi is, the authors describe the appropriate techniques for isolation, enumeration and identification of food-borne fungi and yeasts, especially of xerophilic and thermoresistant species, and also techniques for the preservation of fungus cultures and for safe laboratory housekeeping. The main part of the book is devoted to keying, describing and illustrating quite a large number of genera and species occuring on foods. Keys are primarily based on culture characters in different growth conditions and on micromorphology. Descriptions are complemented by numerous data on ecology and occurence, with bibliographic references. The final chapters cover spoilage of fresh and perishable foods, such as fruits, vegetables, dairy products, meats, and spoilage of dry-stored, processed and preserved foods. The book is designed as a laboratory guide for food microbiologists. Although the book aims at accurate recognition of food-borne fungi, it is written in such a way to be used by many with little prior knowledge of mycology.

FUNGORUM RARIORUM ICONES COLORATAE, PARS XV (Cortinarius), by BON, M., 25 pp., 8 col. pl., 17 X 24 cm, paperback, in the French language, 1986. J. Cramer in der Gebrüder Borntraeger Verl., D-1000 Berlin, Germany. DM 40.- ISBN 3-443-69001-7.

This issue of the collection deals with rare species or varieties of *Cortinarius* , critically described and excellently depicted. They are *Cortinarius rapaceus* var. *caesiovergens*, C. *subturbinatus*, *C. glaucopus* var. *olivaceus*, *C. arcuatorum*, *C. nanceiensis* var. *bulbopodius*, *C. russeus*, *C. balteatus*, *C. cumatilis* var. *robustus*, *C. rufoalbus*, *C. fluryi*, *C. camphoratus*, *C. azureovelatus*, *C. miltinus*, *C. pseudocolus*, *C. plumbosus*, *C. scriptor*, *C. frangrantior*, and *Dermocybe anthracina.*

THE ASCOMYCETE GENUS CHAETOMIUM, by von ARX, J.A., J. GUARRO and M.J. FIGUERAS, Beihefte zur Nova Hedwigia 84, 162 pp., 62 fig., 92 pl., 17 x 24 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger, Johannesstrasse 3A, D-7000 Stuttgart, Germany. ISBN 3-443-51005-1.

Since the first monograph of the genus *Chaetomium* by Zopf (1881) and the subsequent ones by Bainier, Chivers, Ames and Seth, the number of species has reached 210. Considering that successive monographers often reproduced previous species descriptions uncritically, the authors' aim is to achieve a more useful delimitation of species, mainly based on characters of the ascospores and asci and the surface of the ascomatal wall, as proposed by Sörgel and Dreyfuss. Less attention has been paid to the hairs which proved to be variable in some species. On the basis of numerous type specimens, some of which having been revived from the herbarium, and of some 500 living isolates, 92 species are accepted, 87 of which are redescribed and 5 described as new. All other taxa are revised and synonymized, 29 of which are synonymized to *Chaetomium globosum*. All accepted species are illustrated by optical and electron microscopy photographs of ascomata, hairs and ascopores. A long dichotomous key is provided. A synoptic key might have been most useful too.

THE FUNGI OF OUR MOULDY EARTH (a compilation), by COOKE, W.B., Beihefte zur Nova Hedwidgia 85, 467 pp., 114 fig., 17 x 24 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany. DM 160.- ISBN 3-443-51006-X.

Although the title of this book might suggest a comprehensive study of the overall incidence of the fungi in the world, it is a report of the fungus flora collected from organically enriched habitats such as soils, sewage, sewage-polluted stream waters and sewage-treatment systems in some areas of the United States. Habitats are listed and described. 940 filamentous and yeast fungi are described and keyed out in keys adapted from other authors. A number of taxa remain unidentified. 114 pencil line drawings are produced, many of them redrawn from other authors. From a table of the quantitative records in the various habitats, relative frequency of the taxa can eventually be evaluated.

A LABORATORY GUIDE TO COMMON PENICILLIUM SPECIES, by PITT, J.I. 184 pp., ill., 21 x 30 cm, spiral bound, 1985. CSIRO Division of Food Research, P.O.Box 52, North Ryde, N.S.W. 2113, Australia, US $28 plus air postage.

This manual is designed as an easily read guide to the identification of the 48 most common *Penicillium* species. Ten species of *Eupenicillium* and 6 of *Talaromyces*, with *Penicillium* anamorphs, are included. For each species a one half page description is provided, accompanied by notes on distinctive features, known variations in culture, closely related species and occurrence. On the page facing the description are clear photographs of colonies in Czapek-yeast-agar and malt-agar used as standard identification culture media, and of morphological features seen under Nomarsky contrast microscopy. This guide is a simplification of Pitt's monograph "The genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces*" (1979) and will greatly help in introducing microbiology students to this difficult group of fungi.

THE AGARICALES (GILLED FUNGI) OF CALIFORNIA, by THIERS, H.D., 208 pp., 14 x 21 cm, loose-leaf, from 1982. Mad River Press, Rt 2, Box 151-B, Eureka, California 95501, USA. ISBN 0-916422-24-0.

Five parts have been recieved, 1. Amanitaceae (53 pp., 6 col. pl., 1982), 2. Cantharellaceae (34 pp., 1985), 3. Gomphidiaceae (20 pp., 1985), 4. Paxillaceae (9 pp., 1985) and 5. Hygrophoraceae (by David L. Largent, 208 pp., 1985). A conservative estimate of the agaric flora of California places the number of species up to almost 2000 species. The increasing interest in these fungi either as source of food or agent of mycorrhizae has generated a high demand for extended information on their identification. It is the purpose of this serial publication to present in an orderly manner as comprehensive as possible descriptions of the local flora. Seventen families will be considered, keys to genera and species provided, besides descriptions, index and references to literature. No line drawings have been issued, but there are some colour photographs of *Amanita* species.The number of species will depend on the genus: 27 are described in *Amanita*, 135 in *Hygrophorus*.

NORTH AMERICAN SPECIES OF CLITOCYBE. PART II., by BIGELOW, H.E., Beihefte zur Nova Hedwigia 81, 471 pp., fig. 103-204 in 49 pl., 17 x 25 cm, cloth hardcover, 1985. J. Cramer in der Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany. ISBN 3-443-51001-9.

This issue follows Part I published as Beihefte zur Nova Hedwidgia 72 in 1982. The subgenera *Clitocybe*, with six sections, and *Cystoclitus* had been considered. In this second part, four additional sections in subgenus *Clitocybe*, two sections in subgenus *Pseudomyophyllum* and subgenera *Mutabiles, Atroviridae* and *Lazulinae* are described and mainly illustrated by photographs of carpophores. The completed revision of the genus covers 217 accepted North American species and 9 additional of uncertain position. 39 species and varieties are new. There is no need to emphasize the high quality of the contents of the book if one knows the author.

FUNGI PATHOGENIC FOR HUMANS AND ANIMALS. PART B. PATHOGENICITY AND DETECTION:II. by HOWARD, D.H., xiv + 381 pp., ill., 18 x 26 cm, cloth hardcover, 1985. Marcel Dekker Inc., 270 Madison Avenue, New York, NY 10016, U.S.A. $95.25. ISBN 0-8247-7081-1.

This last volume includes chapters on the nutrition, physiology and metabolism of zoopathogenic fungi, comparative cell wall polysaccharide and protein composition, fungal intracellular viruses in relation to fungal growth, toxicity and pathogenicity, phagocytic mechanisms in the host response toward the invader and the epidemiology of the mycoses. Characteristics of the pathogenic fungi in host tissues are described and lead to the techniques for their detection in tissues and their culture in axenic condition. A special chapter deals with the conservation, collection and distribution of cultures of fungal pathogens. Another chapter summarizes the wide research field of host immunological response to the infection and the production of fungal vaccines. A last, additional chapter shows the taxonomic problem in *Exophiala* and related genera such as *Phialophora* and provides a new key for the identification of their species.

FUNGI OF THE HEBRIDES, by DENNIS, R.W.G., ii + 383 pp., 15 x 24 cm, 2 maps, paperback, 1986. Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK. £7.75. ISBN 0-947643-02-8.

This book catalogues the 2932 species of fungi that have been collected by the author and others on the archipelago of the Hebrides, west of Scotland. Most of the areas are natural peat moorland and pasture, with some native oak and birch woods in glens, besides extensive recent plantations of conifers in some parts.These fungi represent almost 50% of the known British mycoflora and a higher percentage of the moorland and pasture flora. Species are listed in their respective phyla and genera are arranged alphabetically. Their occurrence and host in the Hebrides are given together with their presence in the British flora.

GENETISCH UNTERSUCHUNGEN ZUR AFLATOXINBILDUNG IN DEN SCHIMMEL-PILZEN ASPERGILLUS FLAVUS AND ASPERGILLUS PARASITICUS, by SCHMIDT, F.R., Bibliotheca Mycologica 100, 98 pp., 15 ill., 6 tabl., 14 X 22 cm, paperback, 1985. J. Cramer in der Gebrüder Borngetraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany.

Comparative investigation on toxigenic and non-toxigenic strains of *Aspergillus flavus*, NRRL 6515 and NRRL 5565 respectively, and on toxigenic and non-toxigenic strains of *Aspergillus parasiticus*, AUA 528 and NRRL 502 respectively, revealed in the non-toxigenic strains the presence of a virus composed of three RNA double-stranded segments, similar to the virus existing in *Penicillium chrysogenum*. The application of an inhibitor of the RNA synthesis to the non-toxigenic strains unlatches the aflatoxin synthesis and annihilates the virus as well. The reinfection of the same strains by the *Penicillium chrysogenum* virus suppresses the inhibitor effects and represses aflatoxin synthesis. The *Penicillium chrysogenum* virus might be therefore a potential means of biological control of aflatoxin production.

HONGOS PARASITOS EN CONIFERAS DE AMERICA DEL SUR con especial referencia a Chile, by BUTIN, H. and H.L. PEREDO, Bibliotheca Mycologica 101, 100 pp., 33 fig., 14 x 23 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger Verlag., Johannesstrasse 3A, D-7000 Stuttgart, Germany. ISBN 3-443-59002-X.

Forests, especially pine forests, in South America are of economic importance. Studies of the pathogenic fungi in forests are scare and spread in foreign publications. A compilation of information on the identification, description, host range and pathogenicity of 28 of those fungi as they occur on *Pinus* species and other coniferous trees in Chile is presented in the Spanish language. It covers *Ceratocystis, Appendiculella, Caliciopsis, Corynella, Chloroscypha, Lachnellula, Cyclaneusma, Hypoderma, Lophodermium, Arnaudiella, Atopospora, Massarina, Phaeocryptopus,* and *Scirrhia* species in the Ascomycetes, seven species of Basidiomycetes and ten of Deuteromycetes. This paper should be of use to South American plant and forest pathologists.

EXTRACHROMOSOMALE IN-VITRO-GENETIK BEI PILZEN. CHONDRIOM-VEKTOREN BEI HEFEN, by LANG-HINRICHS, Christine, Bibliotheca Mycologica 102, 124 pp., 11 fig., 12 tabl., 14 x 22 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany.

In view of understanding the gene transfer in gene technology, the replication processes of mitochondrial DNA vectors are investigated in *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe*, as homologous and heterologous host organisms respectively. It has been found that the autonomy of the DNA replication of the vectors depends on the homologous or heterologous character of the host.

TYPE STUDIES OF NORTH AMERICAN AND OTHER RELATED TAXA OF STIPITATE HYDNUMS: GENERA BANKERA, HYDNELLUM, PHELLODON, SARCODON, by BAIRD, R. E., Bibliotheca Mycologica 103, 89 pp., 14 x 22 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000, Germany. ISBN 3-443-59004-7.

The author reexamined all type specimens of 123 North American species, including some potentialy related ones also occuring in Europe or in the tropics, in the genera *Bankera, Hydnellum, Phellodon* and *Sarcodon*. Redescription of the macro- and microscopic features of the preserved material after rehydratation in 8% KOH and freehand sectioning, including chemical reaction in KOH and NH_4OH are produced for each taxon. The original description is quoted for comparison when it is doubtfully written on the basis of fresh material. Remarks about the type status of the material and taxonomic comments are beneficially added, but no formal nomenclatural decisions are taken. This is a working document, welcome for any further taxonomic study of these genera and any identification of their species.

STUDY OF THE STIPITATE HYDNUMS FROM THE SOUTHERN APPALACHIAN MOUNTAINS. GENERA BANKERA, HYDNELLUM, PHELLODON, SARCODON, by BAIRD, R.E., Bibliotheca Mycolgica 104, 156 pp., 14 x 22 cm, paperback, 1986. J. Cramer in der Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany. DM 70.- ISBN 3-443-59005-5.

The author collected a very large number of representatives of the four genera from the southern part of the Appalachian Mountains, in Alabama and Virginia, recognized and described thirty-one species, one in *Bankera*, twelve in *Hydnellum*, ten in *Sarcodon* and eight in *Phellodon*, one of which is new but unnamed. The trees and shrubs associated with the species in a number of the collecting sites have been carefully identified and enumerated, in order to assert a possible mycorrhizal association. Furthermore, the basidiocarps were analysed for the presence of terphenylquinones, specifically atromentin, aurantiacin and thelephoric acid, as chemotaxonomic criteria.

ENZYMATISCHE REGULATION DES FRUCHTKÖRPERWACHSTUMS BEI BASIDIOMYCETEN: Entwicklung eines Modells am Beispiel des Pleurotus ostreatus (Jacq. ex Fr.) Kummer, by MULLER, J., Bibliotheca Mycologica 106, 186 pp., 22 fig., 11 tabl., 14 x 22 cm, paperback, 1986. J. Cramer in Gebrüder Borntraeger Verlag, Johannesstrasse 3A, D-7000 Stuttgart, Germany. ISBN 3-443-59007-1.

The growth of fruitbodies in Basidiomycetes requires non-polar insertion of new cell wall material. This presupposes partial lysis of existing cell wall polysaccharides by endogenous cell wall-degrading enzymes. *Pleurotus ostreatus*, grown on a sterilized Cassia substrate, is investigated in that respect. The activity of these glucanolytic and chitinolytic enzymes appeared to be linked to the strain's temperature tolerance for growth. Tolerant strains show a lower enzymatic activity than thermosensitive strains. The activity of the cell wall-degrading enzymes is regulated by the cell wall proteases which are temperature and pH sensitive and are responsible for the thermosensitivity of the *Pleurotus ostreatus* strains in carpophore production. Accessorily, this publication provides useful information on the cultivation and crop protection of the oyster mushroom.

FUNGAL DIMORPHISM, with emphasis on fungi pathogenic for humans, by SZANISZLO, P.J. and J.L. HARRIS, xviii + 395 p., 58 fig., 16 x 23 cm, cloth hardcover, 1985. Plenum Press, 233 Spring Street, New York, NY 10013, USA. $65. ISBN 0-306-42020-1.

The adaptability of fungi to different growth conditions may result in very different morphologies. That is the case in common or occasional zoopathogenic fungi. They display shapes in host tissues distinct from their usual morphology in the natural environment.The phenomenon has been called dimorphism by medical mycologists. Specialists have contributed by the study of the adaptative mechanisms in different fungi within three groups. The first group consists of fungi having a yeast phase in the host and a sporulating hyphal phase in the saprophytic condition. *Ajellomyces dermatitidis, Emmonsiella capsulata, Paracoccidioides brasiliensis* and *Sporothrix scheckii* are amongst them. The second group includes *Candida albicans, Exophiala werneckii* and *Wangiella dermatitidis*. Those are predominantly yeast-like in culture and yeast exhibiting a tendency to be hyphal in vivo. The third group is hyphal in culture and in saprophytic natural conditions but produces enlarged cells in host tissues. *Chrysosporium parvum, Phialophora verrucosa,* and *Coccidioides immitis* are included. Much research has been carried out and is reported that deals with wall composition, wall synthesis and degradation, polysaccharides and enzymatic systems, antigens and immunological response, and wall ultrastructure in both phases of these fungi. Differences have been observed between yeast and hyphal walls of the same fungus, but the mechanism of differentiation is still far from clear. This well-illustrated book is not only a source of abundant information but an expression of our progress towards a biochemical explanation of that important adaptative response of fungal life.

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NOTICE

IMC4 REGENSBURG (1990), FIRST CIRCULAR

The First Circular of the Fourth International Mycological Congress has now been distributed to most mycologists through mailings of mycological societies and journals. The Congress will be held in Regensburg, West Germany, from August 28th through September 3rd, 1990. Anyone interested in attending who has not received the First Circular should request one from:

International Mycological Congress
Prof. Dr. A. Bresinsky
Botanisches Institut der Universität
Postfach 397
D-8400 Regensburg
Federal Republic of Germany

The First Circular contains a Return Form which should be completed as soon as possible in order to receive the Second Circular.

SEE ERRATA

AUTHOR INDEX, VOLUME THIRTY-THREE

Abbott, Sean P., and R. S. Currah, The genus *Helvella* in Alberta 229-250

Ammirati, Joseph F., *Dermocybe* (Cortinariaceae, Agaricales): North American names — new combinations, synonyms and notes 437-446

Anon., NOTICE: IMC4 Regensburg (1990), First Circular 497

Berbee, Mary, see **Vánky and Berbee**

Blackwell, Meredith, see **Gilbertson and Blackwell**

Brunner, Ivano L., and Orson K. Miller, Jr., *Calocybe fallax:* its ecology and cultural behavior 41-50

Butler, E., D. Fogle, and M. Miranda, *Galactomyces citri-aurantii* a newly found teleomorph of *Geotrichum citrii-aurantii* the cause of sour rot of citrus fruit 197-212

Buyck, Bart, Étude microscopique de specimens types de Russules tropicales de la sous-section *Diversicolores* 57-70

Buyck, Bart, Étude microscopique de specimens types de Russules tropicales de la sous-section *Pluviales* 71-80

Capelari, Marina, and Rosana Maziero, Two new species of Agaricales from Brazil 191-196

Carris, L. M., and D. A. Glawe, *Dictyochaeta heteroderae,* comb. nov. 23

Chaverri, Adelaida, see **Sieverding & al.**

Currah, R. S., see **Abbott and Currah**

Elix, John A., see **Lumbsch & al.**

Elix, John A., Gillian J. Jenkins, and H. Thorsten Lumbsch, Chemical variation in the lichen genus *Diploicia* (Ascomycotina) 457-466

Elix, John A., and Jen Johnston, Further new species of *Relicina* and *Xanthoparmelia* (lichenized Ascomycotina) from the southern hemisphere 353-364

Elix, John A., and Jen Johnston, New species and new reports of *Flavoparmelia* (lichenized Ascomycotina) from the southern hemisphere 391-400

Fletcher, Anthony, and Mason E. Hale, New *Xanthoparmelia* (lichenized Ascomycotina) from Brazil 279-280

Fogle, D., see **Butler & al.**

Frank, Harald M., and Heinz Zwanziger, Macrochemical color reactions of macromycetes. VI. Cluster analysis of color data 91-96

Funk, A., see **Hunt and Funk**

Furuya, Kouhei, see **Udagawa and Furuya**

Gamundí, Irma J., and Horacio A. Spinedi, Ascomycotina from Antarctica 467-482

Gilbertson, R. L., and Meredith Blackwell, Some new or unusual corticioid fungi from the Gulf Coast region 375-386

Glawe,, D. A., see **Carris and Glawe**

Hale, Mason E., New combinations in the lichen genus *Xanthoparmelia* (Ascomycotina: Parmeliaceae) 401-406

Hale, Mason E., see **Fletcher and Hale**

Hjortstam, Kurt, José L. Manjón, and Gabriel Moreno, Notes on select corticioid fungi from Spain and North Africa 257-263

Hu, Zhing-xian, see **Zang & al.**

Hunt, R. S., and A. Funk, *Parvacoccum pini* gen. et sp. nov. (Rhytismataceae) on western white pine 51-55

Jenkins, Gillian J., see **Elix & al.**

Johnston, Jen, see **Elix and Johnston**

Johnston, Peter R., A new species of *Meloderma* (Rhytismataceae) with notes on *Meloderma* and related genera 423-436

Kothe, Hans W., see **Lumbsch & al.**
Kubo, Hitoshi, see **Udagawa & al.**
Kuthubutheen, A. J., see **Nawawi and Kuthubutheen**
León-Gómez, Calixto, and Evangelina Pérez-Silva, A new species of *Cyathus* from Mexico 419-421
Lindsey, J. Page, Annotated check-list with host data and decay characteristics for Colorado wood rotting Basidiomycotina 265-278
Lumbsch, H. Thorsten, see **Elix & al.**
Lumbsch, H. Thorsten, Hans W. Kothe, and John A. Elix, Resurrection of the lichen genus *Pleurosticta* Petrak (Parmeliaceae: Ascomycotina) 447-455
Manjón, José L., see **Hjortstam & al.**
Maziero, Rosana, see **Capelari and Maziero**
Miller, Orson K., Jr., see **Brunner and Miller**
Miranda, M., see **Butler & al.**
Moreno, Gabriel, see **Hjortstam & al.**
Morgan-Jones, Gareth, Notes on hyphomycetes. LIX. *Curvularia bannonii* sp. nov., an undecribed leaf pathogen of *Jacquemontia tamnifolia* 407-412
Morgan-Jones, Gareth, Notes on hyphomycetes. LX. *Corynespora matuszakii,* an undescribed species with narrow, cylindrical, catenate conidia and highly-reduced conidial lumina 483-487
Morgan-Jones, Gareth, Studies in the genus *Phoma*. XIV. Concerning *Phoma herbarum,* the type species, a widespread saprophyte 81-90
Morgan-Jones, Gareth, Studies in the genus *Phoma*. XV. Concerning *Phoma multirostrata,* a leaf spot-inducing and soil-borne species in warm climates 339-351
Mueller, Gregory M., and Rolf Singer, *Laccaria gomezii,* a new agaric species from the Querceta of Colombia and Costa Rica 223-227
Nawawi, A., and A. J. Kuthubutheen, Additions to *Condylospora* (Hyphomycetes) from Malaysia 329-338
Nishida, Florence H., New species of *Inocybe* from southern California 213-222
Pérez-Silva, Evangelina, see **León-Gómez and Pérez-Silva**
Petersen, Ronald H., and Catherine Scates, Vernally fruiting taxa of *Ramaria* from the Pacific Northwest 101-144
Pfister, Donald H., A note on Grelet's "Les Discomycètes de France" 97-100
Rojas, Isabel, see **Sieverding & al.**
Ryvarden, Leif, Type studies in the Polyporaceae — 20. Species described by G. Bresadola 303-327
Scates, Catherine, see **Petersen and Scates**
Schatz, Scott, *Hypoxylon oceanicum* sp. nov. from mangroves 413-418
Schumacher, Trond, The *Scutellinia* battle; the lost, missing and dead 149-189
Shibaki, Hideomi, see **Udagawa & al.**
Sieverding, Ewald, Adelaida Chaverri, and Isabel Rojas, *Acaulospora splendida,* a new species in the Endogonaceae from Costa Rica 251-256
Singer, Rolf, see **Mueller and Singer**
Spinedi, Horacio A., see **Gamundí and Spinedi**
Udagawa, Shun-ichi, and Kouhei Furuya, *Emericellopsis sphaerospora* and *Kernia peruviana,* two new soil-borne cleistothecial Ascomycetes 291-301
Udagawa, Shun-ichi, Hitoshi Kubo, and Hideomi Shibaki, A new species of *Arthroderma* from Japanese soil 283-289
Uhl, M., Studies on ectomycorrhizae XVI. Ectomycorrhizae formed by *Tricholoma flavobrunneum* and *Betula pendula* and *Tricholoma auratum* and *Pinus silvestris* 1-21
Vánky, Kálmán, Taxonomical studies on Ustilaginales. III 365-374

Vánky, Kálmán, and Mary Berbee, Are there *Thecaphora* species (Ustilaginales) on Gramineae? 281-282

Wetmore, Clifford M., Lichens and air quality in Indiana Dunes National Lakeshore 25-39

Zang, Mu, De-rong Zheng, and Zhing-xian Hu, A new species of the genus *Dictyophora* from China 145-148

Zheng, De-rong, see **Zang & al.**

Zwanziger, Heinz, see **Frank and Zwanziger**

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The Co-Editors express their appreciation to the following individuals who have, prior to acceptance for publication, reviewed one or more of the papers appearing in this volume:

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INDEX TO FUNGOUS AND LICHEN TAXA, VOLUME THIRTY-THREE

This index contains the names of genera, infrageneric taxa, species, and infraspecific taxa. New names are in **boldface,** as are the page numbers on which such new taxa are proposed.

Abrothallus 99
Acarospora
  fuscata 28
  immersa 28
Acaulospora 251
  delicata 254
  longula 254
  myriocarpa 254
  nicolsonii 255
  scrobiculata 251
  splendida 251, **252**, 253-255
  trappei 255
Acetabula 99
Acremonium 291, 292, 295
Acrocordia
  gemmata 28
Adomia
  avicenniae 417
Agaricus
  fallax 43, 48
Agyrium 99
Aigialus
  grandis 417
  parvus 417
Aleuria 99, 160, 175
  phlyctispora 149, **175**
Aleurodiscus 261
  amorphus 267
  cerrusatus 267
  fruticetorum 267
  lividocoeruleus 267
  mesaverdensis 267
Allantoparmelia 448, 452
  alpicola 448, 449
Amanita 91, 92, 94
  citrina 93
  excelsa 93, 94
  fulva 93, 94
  muscaria 93
  pantherina 93, 94
  phalloides 93
  regalis 93
  rubescens 93, 94
Amauroderma
  expallens 309
  preussii 321, 325
  renidens 319
  subrugosum 324
Amblyosporium
  botrytis 291
Amphinema
  byssoides 267
Amylocystis
  lapponica 272
Amylostereum
  chailletii 276
Angiosorus 365, 370
  solani 365, 370
Anisomeridium
  biforme 28
Anomoporia
  albolutescens 272
  bombycina 272, 310
  myceliosa 272
Anthracobia 99
  melaloma 173
Anthracoidea 365
  fuirenae 365, **366**
Antrodia 318
  albida 272, 318, 324
  albobrunnea 272, 309
  gossypina 272
  heteromorpha 272
  hoehnelii 313
  hippophaes 303, 312, **313**
  juniperina 272
  macra 322
  parvula 303, 316, **317**, 322
  pulvinascens 313
  ramentacea 324
  serialis 273
  sinuosa 273
  sitchensis 273
  vaillantii 273
  variiformis 273
  xantha 273, 311
Antrodiella
  liebmannii 322
  romellii 273
  semisupina 314
  versicutis 308
Anzia
  colpodes 28
Aphanoascus 99
Aporpium
  caryae 273
  substuppeus 321
Aposphaeria

  - violacea 81, 84
- Apostemidium 99
- Apostrasseria 55
- Arachnopeziza 99
- Armillaria 42
  - mellea 266
- Arthonia
  - caesia 28, 33
  - diffusa 28
  - dispersa 32
  - pyrrhuliza 28
  - radiata 28, 32
- Arthopyrenia
  - punctiformis 28
- Arthothelium
  - spectabile 28
  - taediosum 28
- Arthroderma 283, 286, 288, 289
  - cajetani 283
  - ciferrii 286, 288, 289
  - **crocatum** 283, **284**-289
  - cuniculi 286
  - curreyi 286, 288
  - insingulare 283
  - otae 283
  - quadrifidum 283
  - tuberculatum 288
  - uncinatum 283
- Arthrosporella 42
- Ascobolus 99
  - denudatus 291
  - insignis 167
  - pulcherrimus 177
- Ascodesmis 99
- Ascophanus 99
- Ascozonus 99
- Aspergillus
  - niger 372
    - var. phoenicis 365, 372
- Aspicilia
  - calcarea 28
  - contorta 28
- Athelia
  - bombacina 267
  - coprophila 267
  - decipiens 267
  - microspora 267
- Auricularia
  - auricularis 277

- Bacidia
  - inundata 28
  - polychroa 28
  - rubella 28
  - suffusa 28
- Belonidium 99
- Belonium 99
- Biatorella 99
  - cyphalea 28
- Bjerkandera
  - adusta 273, 318
- Blitrydium 99
- Botryobasidium
  - botryosum 267
  - pruinatum 267
  - subcoronatum 267
  - vagum 267
- Botryohypochnus
  - isabellinus 267
- Boudiera 99
- Bourdotia
  - eyrei 278
- Bovista 317
- Briardia 99
- Bryoscyphus 470
  - **aestivalis** 467, **468**
  - dicrani 470
- Buellia
  - disciformis 28
  - punctata 28
  - schaereri 28
- Bulgaria 99
  - inquinans 173
  - melastoma 166
- Bulgariella 99
- Byssoporia
  - terrestre 273

- Caerulicium
  - neomexicanum 268
- Calloria 99
  - erythrostigmoidea 480
- Calocybe 41, 48
  - caucasica 41
  - fallax 41, 43-46, 48, 49
- Caloplaca
  - cerina 28
  - cinnabarina 28
  - feracissima 28
  - ferruginea 28
  - flavorubescens 28
  - microphyllina 28
- Caloscypha 99
- Calvulicium 262
- Calycella 99
- Candelaria
  - concolor 28
- Candelariella
  - efflorescens 28
  - vitellina 28

  xanthostigma 30
Caryosporella
  rhizophorae 417
Catapyrenium
  lachneum 30
Catillaria
  nigroclavata 32
Catinella 99
Celidium 99
Cenangella 99
Cenangium 99
Ceraceomyces
  borealis 268
  serpens 268
  sublaevis 268
Ceratobasidium
  cornigerum 268
Cerebella
  andropogonis 281
Ceriporia
  excelsa 273
  purpurea 273
  reticulata 273
  tarda 273, 309
  viridans 273
  xylostromatoides 324
Ceriporiopsis 305
  aneirina 273, 305, 310
  cerrussata 303, **305**, 306
  consobrina 303, 306, **307**
  gilvescens 311
  mucida 273
  pannocincta 273
  subvermispora 273
Cerrena
  meyenii 317
  unicolor 273
Cetraria
  ciliaris 30
Chaetoderma
  luna 276
Cheilymenia 99, 151, 152, 154, 159-164, 166, 170, 171, 174-176, 178, 180, 184, 185
  albescens 150, 151
  alleghenensis 169
  bisetosa 151
  ciliata 152, 163, 179, 180
  coprinaria 159, 160, 173
  coprinella 159
  coprogena 159
  dalmeniensis 160
  flava 162
  glumarum 164
  insignis 167
  lentiformis 170
  pulcherrima 177
  rubra 178
  stercorea 152, 179, 180
  theleboloides 154, 161, 178, 182
  vitellina 160, 184
Chlorosplenium 99
Chrysosporium 283, 284, 288
Ciboria 99
Ciliaria 99, 157, 162, 166, 183
  arctespora 153
  asperior 154
  brunnea 156
  carneosanguinea 157
  caudata 157
  confusa 158
  contorta 159
  coprinaria 159
  fissilis 162
  hinnulea 165
  hirta 165
  hirtococcinea 166
    var. fulvococcinea 163
  laeticolor 168
  lancifera 169
  lapidaria 169
  pilosa 176
  rubicunda 178
  schizospora 179
  staritzii 180
  strasseri 181
  umbrata 182
    var. antarctica 152
  vitellina 184
Cintractia 365
  fuirenae 365, 366, 373
  stipae-barbatae 372
Cistella 476, 477
  dentata 476
  grevillei 467, 474, 476
  polytrichi 471
    var. **antarctica** 467, **471**, 474
Cladina
  mitis 30
  rangiferina 26, 30
  stellaris 26
Cladonia
  bacillaris 30
  bacilliformis 30
  caespiticia 30
  chlorophaea 30
  coniocraea 30
  cristatella 30, 33, 35, 36
  cryptochlorophaea 30
  cylindrica 30
  fimbriata 30

  - furcata 30
  - gracilis 30
  - grayi 30
  - macilenta 30
  - parasitica 30
  - peziziformis 30
  - pleurota 30
  - polycarpoides 30
  - pyxidata 30
  - ramulosa 30
  - rei 30
  - squamosa 30
  - strepsilis 30
  - verticillata 30
- Cladosporium 281
- Clavaria
  - caulifloriformis 113, 114
  - flava 121
- Clavicorona
  - pyxidata 267
- Clavidisculum 476
- Climacocystis
  - borealis 273
- Coccomyces 51, 52, 54, 55, 99
  - heterophyllae 54
  - mertensianae 54
  - papillatus 54
  - strobi 54
- Coccopeziza 99
- Codinaea 23
  - heteroderae 23
- Collema
  - auriforme 30
  - conglomeratum 30
  - flaccidum 30
  - fragrans 30
  - limosum 30
  - tenax 30
- Collybia 42
  - acervata 266
  - racemosa 48
- Columnocystis
  - abietina 276
- Concamarella 448, 453
- Condylospora 329, 337, 338
  - **flexuosa 329**, 330, 334-336, 338
  - **gigantea** 329, 333, **334**-336, 338
  - spumigena 329, 334-336, 338
- Coniophora
  - arida
    - var. arida 267
    - var. suffocata 267
  - olivacea 267
  - puteana 267
- Conotrema
  - urceolatum 30
- Cookeina 176
- Coprinus
  - cinereus 291
  - phlyctidosporus 291
- Coprobia 99
- Coriolopsis
  - badius 322
  - byrsina 305
  - floccosa 309
  - gallica 273
  - pruinatus 305, 314
  - sanguinaria 324
  - telfarii 309, 326
- Coronellaria 99
- Corticium
  - moniliforme 257, 261
- Cortinarius 437
  - aurantiobasis 438
  - aureifolius 438
    - var. hesperius 439
    - var. psammophilus 439
  - cascadensis 439
  - chrysolitus 439
  - croceofolius 442
  - humboldtensis 439
  - huronensis
    - var. huronensis 439
    - var. olivaceus 440
  - idahoensis 440
  - incognitus 440
  - olivaceopictus 440
  - pellstonianus 440
  - psammophilus 437-439
  - pseudotubarius 438
  - rubeus 438
  - sphagneti 441
  - subcroceofolius
    - var. sordidipes 441
    - var. subcroceofolius 440
  - thiersii 441
  - tubarius
    - var. luteofolius 441
    - var. tubarius 441
  - zakii 441
- Coryne 99
- Corynella 99
- Corynespora 483, 484, 486
  - aterrima 484
  - calophylli 484
  - cassiicola 483, 484
  - citricola 486
  - eranthemi 484
  - hemigraphidis 484
  - heterospora 483

  litchii 484
  longispora 483
  matuszakii 483, **484**-486
  ruelliae 484
  viticis 483-486
Crepidotus
  mollis 266
Crinipellis 42
  perniciosa 48
Cronartium
  ribicola 51, 52
Crouania
  lancifera 169
Crustoderma 262, 376
  dryinum 262, 268, 376
  nakasoneae 375, **376**, 377
  sabinicum 261
Cryptodiscus 99
Cryptomyces 99
Cryptoporus
  volvatus 273
Ctenomyces
  serratus 283
Cubonia 99
Cudonia 99
Cudoniella 99
Curvularia 407, 408, 410
  bannonii **407**, 408, 410, 411
  brachyspora 410
  clavata 407, 410
  eragrostidis 407, 408, 410, 411
  intermedia 410
  ovoidea 410
  richardiae 410
Cyathicula 99
Cyathipodia 99
  corium 236
  villosa 249
Cyathus 419
  limbatus 419, 421
  morelensis **419**-421
  olivaceo-brunneus 421
  poeppigii 421
Cylindrobasidium
  corrugum 268
  evolvens 268
Cyphella
  fasciculata 271
  villosa 271
Cyphellopsis
  anomala 271
Cytidia
  salicina 271

Dacrymyces
  abietinus 277
  minor 277
Dacryobolus
  karstenii 268
Daedalea
  aethalodes 307, 311
  conchata 307
  gilvidula 311
  hoehnelii 313
  incana 311, 325
  microsticta 318
  newtonii 317
Daedaleopsis
  confragosa 273
Dasyobolus 99
Dasyscypha 99
  polytrichi 471
Datronia 308
  brunnea-leuca 325
  caperata 325
  decipiens 303, 306, **308**
  mollis 273
  scutellata 317
  stereoides 273
Dendrothele
  malenconii 261
Dermatea 99
Dermatocarpon
  miniatum 30
Dermocybe 20, 437, 438
 subg. Dermocybe 438
 sect. Dermocybe 438
 sect. Holoxanthae 438, 441
 sect. Malicoriae 438, 442
 sect. Sanguineae 438
  aurantiobasis **438**
  aureifolia 437, 439
   var. aureifolia 438
   var. **hesperia** **439**
  cascadensis **439**
  chrysolita **439**
  cinnamomea 20, 438
  croceofolia 437, 442
  holoxantha 441
  humboldtensis **439**
  huronensis **439**, 440
   var. **huronensis** **439**
   var. **olivacea** **440**
  idahoensis **440**
  incognita **440**
  malicoria 437, 442
  olivaceopicta **440**
  palustris 440
   var. sphagneti 441
  pellstoniana **440**
  sanguinea 20

  sphagnogena 441
  subcroceofolia 440
    var. **sordidipes 441**
    var. **subcroceofolia 440**
  thiersii 441
  tubaria 441
    var. **luteofolia 441**
    var. **tubaria 441**
  vulcanica 441
  zakii 441
Desmazierella 99
Dextrinocystis 375, **376**
  capitata 375, **378**, 379
Dichomitus
  squalens 273
Dictyochaeta 23
  fuegiana 23
  heteroderae 23
Dictyophora 145
  echinata 146
  echinovolvata 145, **146**, 148
  indusiata 145, 148
  rubrovolvata 145
Didymella
  urticicola 82
Diploicia 457, 461
  canescens 457, 459, 461-464
    ssp. **australasica** 457, 462, **463**, 465
  subcanescens 457, 459, 464, 465
Diplomitoporus
  crustulinus 273, 308
  flavescens 309
  lenis 273
  lindbladii 273
Diplonaevia 99
Diploschistes
  scruposus 30
Dirinaria 403
Discina 99, 167
Discinella 99
Doassansia 372
  sintenisii 365, 372
Durella 99

Earliella
  scabrosa 307, 317, 326
Echinodontium
  tinctorium 271
Eleutherascus 295
  peruvianus 295
Emericellopsis 295
  sphaerospora 291, **292**, 293, 295, 298
Encoelia 99
Endocarpon
  pusillum 30
Entrophospora
  infrequens 251
  schenckii 251
Entyloma
  asterisci 366
  asterisci-maritimi 365, **366**, 369
  bellidis 365, 367
  catananche 366
  catananchis 365, **366**, 369
  compositarum
    (rank ?) catananchis 366
  mediterraneum 366
  thrinciae 365, 367
Ephelina 99
Epiglia 99
Epithele 257
  canariensis 257
  capitata 375, 378, 386
  fulva 257
  hydnoides 257
Epithelopsis 257
Erinella 99
Evernia
  mesomorpha 30
Everniastrum 448, 453
Exidia
  glandulosa 278
Exoascus 99

Fabraea 99
Fairmania
  singularis 298
Favolaschia 325
Favolus
  balansae 304
Fibricium 262
  multicystidium 257, 261-263
  rude 268
Fibulomyces
  mutabilis 268
Fimaria 172
Flagelloscypha 42
  abruptiflagellata 48
Flammula
  gummosa 48
Flammulina 42
  velutipes 48, 266
Flavoparmelia 391, 394, 397, 448, 453
  diffractaica 391 , 392, 394, 396
  euplecta 391, 393, 395, 398, 399
  glomelliferica 393, 395
  haywardiana 391, **392**-394
  helmsii 391, 392, 396
  jelineckii 395
  neuquenensis 391, **393**-395

  proeuplecta 391, 394, **395**
  rutidota 395, 398, 448, 449
  scabrosina 391, **396**, 397
  secalonica 391, 397, **398**
  springtonensis 392, 393
  succinprotocetrarica 391, 397, **398**, 399
Fomes
  allardi 303
  aulaxinus 304
  dialeri 309
  elaphinus 309
  fulvo-umbrina 310
  fusco-pallens 310
  hippopus 313
  hoehnelii 313
  introstuppeus 309
  latissimus 314
  mcgregorii 315
  pachyderma 317
  pappianus 317
  reichingeri 319
  rufus 321
  subannosus 324
  subendothejus 324
  surinamensis 324
  testaceo-fuscus 324
  validus 325
  velutinus 325
  versicolor 325
  weirianus 326
Fomitopsis
  avellanea 303, **304**
  cajanderi 274
  dochmius 304
  officinalis 274
  pinicola 274
  rosea 274
  spraguei 314

Galactinia 99
Galactomyces 202, 206, 208-210
  citri-aurantii 197, 199, **200**, 202, 204, 206, 208-211
  geotrichum 197, 199, 200, 202, 206, 208-210
  reessii 197, 199-202, 206, 208-211
    var. citri-aurantii 208
Galerina
  autumnalis 266
Ganoderma 314
  applanatum 271, 314
  cacinum 305
  cervinum 305
  chalceum 305
  expallens 309
  fulvellum 310
  hoehnelianum 314
  lucidum 305, 310, 314, 321
  mirabilis 310
  ostracodes 314
  pfeifferi 318
  renidens 319
  rubeolum 321
  rufo-albus 321
  subfornicatum 325
  subrugosum 324
  triviale 325
  tumidum 325
  umbrinum 325
  zonatum 325
Geoglossum 99
Geopora 155, 162, 164, 166, 169
  arenicola 153, 163, 164, 169, 174, 180
  arenosa 153
  pellita 174
  sepulta 180
  sumneriana 181
  tenuis 182
Geopyxis 99
  majalis 160
Geotrichum 209
  candidum 198, 209, 210
    var. citri-aurantii 198
  citri-aurantii 197, **201**, 210, 211
Gloeocystidiellum
  leucoxanthum 268
  porosum 268
Gloeopeziza 99
Gloeophyllum
  imponens 322
  odoratum 274
  protractum 274
  sepiarium 274
  trabeum 274, 319
Gloeoporus
  croceo-pallens 308
  dichrous 274
  taxicola 274
Godronia 99
Grammothele
  cineracea 307
  delicata 309
  lineata 307
  ochraceus 318
  pulchella 303, **318**
  subargentea 318
Graphiola 372
Graphis
  scripta 30, 32
Graphium 298, 300

Gymnopilus
  sapineus 266
Gyromitra 99, 229

Habrostictis 99
Haematostereum
  sanguinolentum 276
Hapalopilus
  croceus 324
  nidulans 274
Hapsidospora 295
  irregularis 295
  milkoi 295
Hebeloma 291
  spoliatum 291
  vinosophyllum 291
Helicobasidium
  corticioides 277
Helminthosporium 483
Helotium 99
Helvella 99, 229, 230, 236, 244
 sect. Acetabulum 229-231, 242, 244
 sect. Crispae 230, 236
 sect. Elasticae 230, 238
 sect. Ephippium 230, 232, 238, 242
 sect. Helvella 230, 236, 239
 sect. Lacunosae 230, 238
 sect. Leucomelaenae 230, 234, 239
 sect. Macropodes 230, 234, 236, 248, 249
 sect. **Silvicolae** 229, 230, 244, **245**
  acetabulum 229-233, 244, 245
  aestivalis 245
  albella 238
  arctoalpina 232
  atra 229, 231-234, 242
  brevis 229, 231, 234, 235, 249
  confusa 229, 231, 234, 235, 239, 249
  connivens 238
  corium 229, 231, 236, 237, 249
  costifera 244
  crispa 229, 231, 236, 237, 242
  cupuliformis 249
  elastica 229, 231, 238, 240
  ephippium 229, 231, 238, 240, 242
  hyperborea 244
  lacunosa 229, 231, 238, 239, 241, 242
  leucomelaena 229-231, 234, 239, 241, 245
  macropus 249
   var. brevis 234
  maculata 229, 231, 239, 242, 243
  mitra 238
  pezizoides 229, 231, 232, 238, 242, 243
  queletii 234, 248
  robusta 229-231, **242**, 244-246, 249
  silvicola 229, 230, 244, 245, 247
  solitaria 229, 231, 234, 247, 248
  stevensii 238
  subglabra 232
  sulcata 238, 239
  unicolor 244
  villosa 229, 231, 248, 249
Henningsomyces
  candidus 271
Heppia
  lutosa 30
Hericium
  americanum 271
Heterobasidion
  annosum 274
Heterodermia
  granulifera 30
  speciosa 30
Heterosphaeria 99
Heterotextus
  alpinus 277
Hexagonia
  cuprea 308
  expallida 309
  tenuis 308
  umbrina 325
  wildemanii 326
Humaria 99
 subg. Ciliaria 178
 'tribe' Ciliaria 157
  alpina 152
  arenosa 153
  carneosanguinea 157
  delectans 160
  flava 162
  gregaria 164
  hemisphaerica 165
  irregularis 167
  miniata 173
  sublivida 181
  subreticulata 181
  tenuis 182
  umbrata
   f. pallida 183
Hyalinia 99
Hyaloscypha 99
Hygrocybe
  chloochlora 194
  viridis 191, **192**, 194, 195
Hymenochaete
  arida 271
  cinnamomea 271
  fuliginosa 271
  rubiginosa 271
Hymenoscyphus 470
Hyperphyscia

  adglutinata 30
Hyphoderma 257, 261, 262
  amoenum 268
  anasaziense 268
  argillaceum 268
  cremeoalbum 268
  definitum 258
  galactinum 257, **258**-260
  litschaueri 261
  malenconii 257, **261**
  medioburiense 268
  moniliforme 261
  multicystidiatum 261
  mutatum 268
  nudicephalum 375, **378**, 380, 381
  pratermissum 268
  puberum 268
  sabinicum 257, 261, 262
  sambuci 268
  setigerum 268, 380
  sibiricum 268
  subdefinitum 258
Hyphodontia 262
  alutacea 268
  alutaria 268
  arguta 268
  aspera 268
  breviseta 268
  crustosa 268
  floccosa 268
  hastata 269
  microspora 375, 380, 382, 383
  orasinusensis 375, **382**, 383
  pallidula 269
  spathulata 269
  subalutacea 269
Hypochnicium
  bombycinum 269
Hypoderma 423
  desmazieresii 423
Hypogymnia
  physodes 30
Hypoxylon 413, 417
  oceanicum 413-417
  quisquiliarum 414, 416
Hypsizygus
  marmoreus 266

Imshaugia
  aleurites 30
Inocybe 213, 216, 219
  auricoma 214, 215
  chrysocephala 213, 215, **216**
  cryptocystis 218
  cylindrocystis 218
  geophylla 218
  hemileuca 213, **219**-221
  hirtella 214, 215
  hirtelloides 215
  insinuata 218
  kauffmanii 214, 215, 218
  menthi-gustans 213-**215**, 218
  mycenoides 215
  nitidiuscula 220
  ochraceomarginata 214, 215
  ochroalba 218
  olympiana 215
  pseudodestricta 220
  sindonia 218
  subdestricta 220
  subochracea 214, 215
  vaccina 214, 215
Inonotus
  andersonii 271
  circinatus 271
  dryadeus 271
  dryophilus 271, 310
  patouillardii 310
  rheades 271
  subiculosus 272
  tomentosus 272
Irpex
  lacteus 274
Ischnoderma
  resinosum 274

Jafnea
  fusicarpa 163
  semitosta 164
Jafneadelphus
  tectipus 175
Jahnoporus
  hirtus 274
Junghuhnia
  carneola 305
  collabens 274
  crustacea 309
  luteoalba 274
  separabilima 274
  zonata 326

Karschia 99
Kavinia
  alboviridis 269
  himantia 269
Kernia 298
  hippocrepida 298
  peruviana 291, **295**, 297-300
Knieffiella
  fibrosa 269
Kotlabaea 160

Laccaria 223, 226
  amethystea 223, 226
  amethysteo-occidentalis 226
  amethystina 226
  calospora 226
  gomezii 223, **224**-226
  laccata 223
  tetraspora 223
  vinaceobrunnea 226
Lachnea 99, 157, 161, 162, 167
  subg. Scutellinia 157
  subg. Sepultaria 185
  acerina 150
  affinis 150
  antarctica 152
  arenosa 154
  austriaca 156, 167
  boudieri 156
  carneosanguinea 157
  contorta 159
  coprinella 159
  fimbriata 162
  hirta
    var. alnea 152
    var. populnea 177
  hystrix
    var. carpathica 167
    var. prunicola 167
  lasioboloides 170
  lentiformis 170
  livida 178
  loennbohmii 171
  longiseta 171
  lusatiae
    var. macrospora 172
  ochroleuca 174
  olivascens 178
  pallida 174
  palustris 174
  piliseta 176
  regalis 177
  rubra 178
  rufobrunnea 178
  scheremetjeffii 178
  scutellata 171
    var. alnea 151
    f. depauperata 160
  superba 181
  umbrata
    f. antarctica 152, 183
  umbrorum
    var. pratensis 177
    f. arenosa 153
  violacea 183
  werthiana 184
  wimpfeniana 184
Lachnella 99
Laeticorticium
  roseum 269
Laetinaevia 480
  colobanthi 467, **478**
  erythrostigma 480
Lambertella 99
Lamprospora 99, 169, 176, 180, 474
  cashiae 474
  crec'hqueraultii 155
Laquearia 99
Lasiobolus 99, 170
  ciliatus 161
Lasiostictis 99
Laurilia
  sulcata 276
Lecania
  erysibe 31
  perproxima 31
Lecanidion 99
Lecanora 447
  allophana 31
  argentata 31
  dispersa 31
  hagenii 31
  pallida 31
  populicola 31
  saligna 31
  sambuci 31
  symmicta 31, 32
  thysanophora 31
  varia 31
Lecidea 447
  enteroleuca 33
  varians 31
Lecidella 33
Leciographa 99
Lentinellus
  cochleatus 266
  montanus 266
  ursinus 266
Lenzites
  scruposa 322
  spegazzinii 323
Leotia 99
Lepidotia 99
Lepraria
  finkii 31
Leptogium
  chloromelum 31
  corticola 31
  lichenoides 31
  saturninum 31

Leptoglossum 99
Leptopodia 99
  atra 232
  elastica 238
  ephippium 238
  pezizoides 242
Leptoporus
  mollis 274
Leptorhaphis
  epidermidis 31
Leptosphaeria
  doliolum
    var. doliolum 82
Leptosporomyces
  galzinii 269
  mundus 269
Leucogyrophana
  mollusca 269
  olivascens 269
  pseudomollusca 269
Leucoscypha 99
Lichen
  acetabulum 453
Lophiostoma
  lignatilis 417
  mangrovis 417
Lophodermium 423, 424, 434
  conigenum 427, 430, 434
  melaleucum 434
  pinastri 423, 427, 430, 431, 434
  pyrolae 427, 428, 433, 434
  seditiosum 430
  sphaerioides 427-429, 433, 434
Lophomerum 423, 424
  rhododendri 427, 428, 430, 433, 434
Lyophyllum 41
  tylicolor 291

Macropodia 99
Marasmius 42, 214
  ionides 192
  jaruensis **191** -193
  limosus 48
Melachroia 99
Melanelia 403, 447, 448, 452, 453
  acetabulum 447, 448, 453
  disjuncta 448, 449
  koflerae 448
  panniformis 448, 450
  stygia 448, 450, 453
Melascypha 99
Melaspilea 99
Melastiza 99, 155, 156, 159, 169, 170, 175, 178, 182
  asperula 155, 169
  chateri 159, 173
  flavorubens 156, 182
  laeticolor 149, 155, **168**
Melittosporium 99
Meloderma 423, 424, 434
  desmazieresii 427, 430, 432-434
  dracophylli 423, **424**, 425, 427, 428, 433, 434
  richeae 423-425, 427, 428, 433, 434
  sharmarum 423, 427, 430, 433, 434
Meruliopsis
  albostramineus 269
  ambiguus 269
  hirtellus 269
Micarea
  prasina 31
Microascus 298
  caviariformis 292
  tardifaciens 292
Microbotryum 372
  violaceo-verrucosum 365, **372**
Microglossum 99
Micropodia 99
Microporellus
  obovatus 310, 311
Microsporum 288
Mitrophora 99
Mitrula 99
Mniaecia 99
Mollisia 99
Mollisiella 99
Morchella 99
Mucronella
  aggregata 271
Myceliophthora 288
Mycena 42
  overholtsii 266
Mycoacia
  fuscoatra 269
Mycobacidia 99
Mycobilimbia 99
Mycomicrothelia
  thelena 33

Naevia 99
Nannizzia 288, 289
Navisporus
  floccosa 309
Neofuscelia 448, 452
  pulla 448, 450
Neolentinus
  lepideus 266
  ponderosus 266
Neottiella 100, 157, 175, 176
Nesolechia 100
Niptera 100

Nothojafnea 183

Ocellaria 100
Octospora 474
  ciervensis 467, **472**, 474
  moraveci 474
  villosa 249
  wrightii 474
Odontia
  coloradensis 269
  furfurella 384
Odonticium
  laxum 269
Odontotrema 100
Oidium
  candicans 269
  citri-aurantii 198, 201
Oligoporus
  balsameus 274
  caesius 274
  floriformis 274
  fragilis 274
  leucomallellus 274
  leucospongia 274
  obductus 274, 315
  perdelicatus 274
  placentus 274
  rancidus 275, 319
  sericeomollis 275
  stipticus 275
  undosus 275
Ombrophila 100
Oospora
  citri-aurantii 198
Opegrapha
  atra 31
  varia 31
Orbilia 100
Otidea 100
  auricula 244
  silvicola 244
Oxyporus
  corticola 275, 325
  cuneatus 275
  latemarginatus 304
  pellicula 318
  populinus 275
  similis 275, 322

Pachydisca 100
Pachyella 100
Panaeolus 214
Panus
  rudis 266
Paraparmelia 448, 453
Parascutellinia 152, 157, 184
  arctespora 149, **153**, 184
  carneosanguinea 157
  violacea 153, 183
Paratrichophaea 151
  albescens 149, **150**
  macrocystis 150
Parmelia 447
  adplanata 403
    var. isidiigera 403
    f. isidiigera 403
  adpressa
    var. endochrysea 403
  amableana 401
  angustiphylla 401
  applanata 403
  aurulenta 32
  australis
    var. platyphylla 404
    var. stenophylla 404
  bibax 401
  bolliana 31
  borreri 31
  caperata 31
  ceresina 402
  cetrata 31
  clivorum 402
  coniocarpa 31
  conspersa 31
    var. angustiphylla 401
    var. coloradoensis 402
    var. felkaensis 403
    var. hypoclysta 406
    var. pulvinaris 405
    f. alpigena 403
    f. felkaensis 403
    f. planilobata 405
    f. subterricola 405
  constrictans
    f. inactiva 404
  convexula 402
  convoluta
    var. pseudohungarica 405
  coreana 402
  crinita 31
  desertorum 402
    f. desertorum 402
    f. neodesertorum 402
    f. typica 402
  endochrysea 403
  flaventior 31
  galbina 31
  geesterani 403
  imitans
    var. coloradoensis 402

    - f. verrucosa 405
  - inuncta 403
  - koflerae 453
  - kurokawae 404
  - lavicola 404
  - laxa
    - var. pulvinaris 405
    - var. terricola 405
  - leonora 404
    - var. leonora 404
    - var. multifida 404
    - var. platyphylla 404
  - marroninipuncta 404
  - molliuscula
    - f. desertorum 402
  - monticola 404
  - neoconspersa 404
  - perforata 31
  - phaeophana
    - f. coloradoensis 402
    - f. verrucosa 405
  - pseudohungarica 405
    - var. vacensis 405
  - pulvinaris 405
    - var. hungarica 405
    - var. terricola 405
    - f. lacinulata 405
    - f. terricola 405
  - punctulata 405
  - rudecta 31
  - spargens 406
  - squarrosa 31
  - stenophylla
    - f. pulvinaris 405
  - subaurifera 31, 33
  - sublaevis 406
  - sulcata 31, 33
  - taractica
    - var. pseudohungarica 405
    - var. pulvinaris 405
    - var. vagans 402
    - f. desertorum 402
    - f. hypoclysta 406
  - tinctina
    - var. xizangensis 406
  - unctula 406
- **Parvacoccum** **52**, 54, 55
  - **pini** 51, **52**, 54
- Paryphedria 100
- Patella 162
  - michiganensis 173
  - stercorea 180
  - umbrorum 165
- Patellaria 100
- Patinella 100
- Paxina
  - acetabulum 231
  - barlae 231
  - corium 236
  - dupainii 248
  - leucomelas 239
  - nigrella 236
  - platypodia 248
  - subclavipes 234
  - sulcata 231
- Pelodiscus
  - piliseta 176
- Peltigera
  - rufescens 31
- Peniophora
  - cinerea 269
  - incarnata 269
  - nuda 269
  - polygonia 269
  - pseudoversicolor 269
  - rufa 269
  - septentrionalis 269
  - violaceo-livida 269
- Perenniporia
  - contraria 324
  - ellisiana 275
  - fulviseda 310
  - **latissima** 303, **314**
  - martius 313, 314
  - medulla-panis 275
  - **straminea** 303, 320, **323**
  - **straminella** 303, 320, **323**
  - subacida 275
  - tenuis
    - var. pulchella 275
    - var. tenuis 275
- Peristomialis 100
- Perrotia 100
- Pertusaria
  - leucostoma 31
  - multipuncta 33
  - pertusa 33
  - pustulata 31
  - velata 31
- Petriella 298
  - proteophila 292
- Pezicula 100
- Peziza 100, 162
  - ser. Lachnea 166
  - 'tribe' Humaria 162
  - 'tribe' Sarcoscyphae 157, 158, 166, 176
  - 'subtr.' Ciliares 157, 158, 166, 176
  - acetabulum 231
  - adusta 150
  - albobadia 151
  - albocincta 176

albospadicea 151
anemone 152
arctespora 153, 184
arenicola 153
articulata 154
ascoboloides 154, 161
asperior 154, 155
aurantiopsis 156
brasiliensis 156
brunnea 156
carneorufa 157
ciliata 178
coelopus 158
confusa
coprinaria 159
coprogena 159
corium 236
cretea 159
crinita 178
crispata 159
dalmeniensis 160
ditricha 161
diversicolor 161
eclecta 161
erecta 162
fissilis 162
flavobrunnea 162
fulvescens 163
fuscoatra 163
fusicarpa 163
geaster 163
gilva 164
glumarum 164
grevillei 474, 476
hainesii 164
hazslinszkia 165
hemisphaerica 165, 168
hinnulea 165
hirta 165-167, 178
hirtipes 166
hirtococcinea 166
  var. fulvococcinea 163
hybrida 166, 167, 170
hystrix 167
imperialis 167
japonica 168
labellum 168
laeticolor 155, 168
lanuginosa 169
  var. sumneri 181
lapidaria 169
laxmannii 170
lentiformis 170, 171
leucomelas 239
livida 171
lugubris 171
luteopallens 172
macrochaeta 172
maculosa 172
martii 172
melaloma 173
melastoma 173
moravecii 291
nigra 173
ochroleuca 174
oligotricha 174
pellita 174
phaeoloma 175
phlyctispora 175
pilosa 176
plumieri 176
polytrichi 176
praecox 177
rhizomorphae 177
rubra 178
schistarenaria 179
schizospora 179
scubalonta 179
scutellata 165
scutelloides 179
sepulta 180
sequoia 180
solitaria 248
stenostoma 180
sumneriana 181
theleboloides 182
umbrata 178, 182
umbrorum 182
  var. labellum 168
umbrosa 155, 183
vinosobrunnea 183
vitellina 184
  ssp. sabulosa 184
woolhopeia 185
wrightii 474
Phacidium 100
Phaeolus
  schweinitzii 275
Phaeomarasmius
  erinaceus 266
Phaeophyscia
  cernohorskyi 31
  chloantha 31
  ciliata 31
  pusilloides 31
  rubropulchra 31
Phaeotrametes
  decipiens 318
Phallus
  crispus 236

- Phanerochaete
  - arizonica 269
  - avellanea 269
  - carnosa 269
  - sanguinea 269
  - sordida 270
  - tuberculata 270
  - velutina 270
- Phellinus 321
  - adamantinus 311, 324
  - allardi 303
  - badius 317
  - chrysoloma 272
  - conchatus 272
  - contiguus 304
  - extensus 325
  - ferreus 272
  - ferrugineofuscus 272
  - ferrugineo-velutinus 321
  - ferruginosus 272
  - gilvoides 305
  - gilvus 305, 324
  - hartigii 272
  - hoehnelii 313
  - igniarius 272
  - **mcgregorii** 303, **315**, 316
  - nigrolimitatus 272
  - nilgheriensis 325
  - pini 272
  - pomaceus 272
  - punctatus 272, 310
  - **reichingeri** 303, 316, **319**
  - rhytiphloeus 324
  - rimosus 304, 309, 317, 324
  - **rufus** 303, 320, **321**
  - setulosus 309, 319
  - tremulae 272
  - tricolor 324
  - umbrinella 325
  - viticola 272
  - wahlbergii 321
  - weirianus 319, 326
- Phialea 100
- Phillipsia 176
  - crispata 160
- Phlebia
  - albida 270
  - centrifuga 270
  - lilascens 270
  - livida 270
  - radiata 270
  - subochracea 270
  - subserialis 270
- Phlebiella
  - filicina 270
  - vaga 270
- Phlebiopsis
  - gigantea 270
  - roumeguerii 270
- Pholiota
  - adiposa 266
  - alnicola 266
  - decorata 266
  - destruens 266
  - spumosa 266
  - squarrosa 266
- Phoma 81, 82, 84, 88, 339, 340, 342, 346, 348
  - sect. Plenodomus 348-350
  - americana 346, 348
  - asparagi 340
  - destructiva 346
  - ehretiae 340, 342
  - eupyrena 81, 346
  - exigua 81
    - var. exigua 81
    - var. ('b') minor 82
  - glomerata 81, 88
  - herbarum 81-84, 86, 88, 89, 339, 348
    - var. lactaria 84
  - hibernica 81, 84, 348
  - hoehnelii
    - var. urticae 82
  - leonuri 350
  - lignicola 81
  - liliana 340, 342
  - lingam 82
  - lucknowensis 340, 342
  - macrostoma 81
  - medicaginis 340, 346
    - var. medicaginis 346
    - var. pinodella 346
  - multirostrata 339, 340, 342, 343, 345, 346, 348, 350
  - nebulosa 82, 88
  - oleracea 82, 84
  - pedicularis 350
  - pigmentivora 81, 84
  - pimprina 339
  - pinodella 346
  - rumicicola 348
  - saprophytica 88
  - sorghina 81
  - sydowii 350
  - terrestre 340
  - terrestris 88, 340, 342
  - urticae 82, 84
  - urticicola 82
  - violacea 81, 84, 88
- Phragmonaevia 100
- Phylloporia

  weberiana 324
Physcia
  adscendens 32
  aipolia 32
  millegrana 32, 33
  stellaris 32
Physconia
  detersa 32
Physomitra 100
Pilacre 100
Piloderma
  bicolor 270
  byssinum 270
Pirottaea 100
Pithya 100
Pithyella 100
Placographa 100
Placynthiella
  icmalea 32
  oligotropha 32
Placynthium
  nigrum 32
Platygloea
  laplata 277
Plectania 168
  coelopus 158
  japonica 168
  melastoma 166, 173, 177
  nannfeldtii 231, 236
Pleurosticta 447, 452, 453
  acetabulum 447, 448, 451, **453**
  koflerae 447, **453**
Pleurotus
  cystidiosus 48
  ostreatus 266
Plicaria 100
Pluteus
  cervinus 266
Pocillum 100
Podosporium 483
Polydesmia 100
Polyporus 317, 319, 322
  alveolaris 275
  arcularius 275
  badius 275
  bosei 305
  canescens 305
  chrysellus 305
  cremeus 308
  crustulinus 308
  cryptopus 275
  devians 309
  ehretiae 309
  elegans 275
  friesii 310
  fumigatus 310
  fuscobadius 310
  fusco-maculatus 310
  goethartii 311
  graffianus 311
  griseus 311
  hoehnelii 313
  hypoxanthus 314
  infernalis 317
  kmetii 314
  leucoxanthus 314
  luteo-velutinus 315
  malacotis 315
  marianii 315
  melaleucus 317
  mucidus 307
  podlachius 318
  radiato-rugosus 319
  retirugis 319
  rickianus 321
  scaber 322
  schumannii 322
  spadiceus 322
  spegazzinianus 320, 322
  squamosus 275
  squamulosus 323
  straminellus 323
  subcapucinus 324
  subgilvus 324
  subpruinatus 324
  subradiatus 324
  subtestaceus 324
  udus 310
  varius 275, 318
Polystictus 319
  melanospilus 317
  moelleri 317
  pallidus 317
  puberulus 318
  radiato-rugosa 319
  revolutus 321
  umbrinellus 325
  umbrinus 325
  vicinus 326
Poria
  ambigua 304
  avellanea 304
  bicolor 304
  carneola 305
  cerussata 305
  cesatii 305
  confusa 307
  consobrina 307, 308
  crustulina 308
  dichroa 309

  eyrei 309
  fagicola 309
  friesiana 310
  fulvella 310
  fulvescens 310
  fulviseda 310
  fumosa 310
  gilvescens 311
  graphica 311
  greschikii 311
  hippophaes 313
  nigrescens 317
  pavonia 318
  porphyrophaea 318
  proxima 318
  rancida 319
  rensii 319
  rickii 321
  similis 322
  straminea 323
  subambigua 324
  torrendii 325
  tricolor 324
  umbrinella 325
  vicina 325
  zonata 326
Porogramme
  graphica 311, 312
Propolidium 100
Propolina 100
Propolis 100
Psathyrella
  candolleana 266
Pseudohydnum
  gelatinosum 278
Pseudombrophila 100, 172
  deerata 291, 172
  luteopallens 149, **172**
Pseudoparmelia 391, 403
  endochromatica 401, 403
  geesterani 403
  pseudosorediosa 393
Pseudopeziza 100
Pseudopiptoporus
  devians 309
Pseudoplectania 100
Pseudorhizina
  sphaerospora 242
Pseudotis 100
Pseudotomentella
  nigra 277
  tristis 277
Psilachnum 477
Psilocistella 477
  deschampsiae 467, **476**, 478
  fonticola 477
  obsoleta 477
Ptychogaster
  rufo-albus 321
Ptychoverpa 100
Puccinia
  atrofusca 388
  holboellii 387
  podophylli 387, 388
  suksdorfii 387
  variabilis 388
  violae 388
Pulvinula 100
Pustularia 100, 152
Pycnoporellus
  alboluteus 275
  fulgens 275
Pycnoporus
  cinnabarinus 275
Pyrenocollema
  prospersella 32
Pyrenopeziza 100
Pyrenula
  laevigata 32
  nitida 33
Pyrofomes
  demidoffii 275
  fulvo-umbrina 310
Pyronema 100
Pyronemella 170
Pyrrhoderma
  scopulosus 317

Radulodon
  americanus 270
Radulomyces
  confluens 270
Ramalina
  americana 32
  calicaris 32
  fraxinea 32
Ramaria 101-103, 107, 112, 120, 122, 125, 126, 139
 subg. Echinoramaria 101
 subg. Laeticolora 101, 103, 109, 117, 120, 128
 subg. Lentoramaria 101
 subg. Ramaria 101, 103, 104, 107, 117, 128
  armeniaca 101, 109, **111**, 112, 117
  botrytis 128
  cartilaginea 113-115
  caulifloriformis 103, 110, 113-115
  celerivirescens 117
  conjunctipes 103
  coralcolor 136
  coulterae 101, 109, 112, **115**, 117, 131

  eryuanensis 108
  flavo-brunnescens
    var. aromatica 117
  formosa 136
  fumosiavellanea 125
  gelatiniaurantia 112
  gelatinosa
    var. oregonensis 103
  gypsea 128
  holorubella 128
  leptoformosa 103
  maculospora 115
  magnipes 106, 118-121, 123, 127, 128, 130
    var. **albidior** 101, 109, **121**-123
    var. magnipes 109, 122
  marrii 101, 109, 117, 122, **123**, 125
  mutabilis 101
  obtusissima 128
  piedmontiana 136
  rasilispora 106, 119-121, 127, 128, 130, 131
    var. rasilispora 110, 126, 128, 130
    var. scatesiana 110, 126, 128-131, 140
  rubricarnata 103, 123, 132, 133, 136, 137
    var. **pallida** 101, 111, **133**, 134, 137, 140
    var. rubricarnata 110, 131, 134, 137
    var. **verna** 101, 111, 126, 133, **135**, 137
  rubrievanescens 105-108, 112
  rubripermanens 103-106, 108, 117, 119, 121
  sandaracina 103
  sanguinea 142
  schildii 128
  spinulosa 125
    var. diminutiva 125
  strasseri 107, 108, 128
  stricta 101
  thiersii 101, 110, 130, 134, 135, **138**-140
  vinosimaculans 110, 119, 131, 139, 140, 142, 143
  xanthosperma 142, 143
Ramsbottomia 155, 169, 180
  asperior 154
Relicina 353
  ramboldii 353 , 354, 356
  sydneyensis 353, 354
Relicinopsis 391, 448, 453
Resinicium
  bicolor 270
  chiricahuaense 270
  furfuraceum 270
Resupinatus
  applicatus 266
Rhizina 100
Rhizopogon 20
Rhodoscypha 152
Rhyparobius 100
Rhytisma 100
Rigidoporus
  crocatus 317
  vinctus 310, 318
Rinodina
  bischoffii 32
  sophodes 33
Russula 91, 92, 94
  sect. Heterophyllae 68
  sect. Pelliculariae 57, 58, 67, 71, 72
  subsect. Amoeninae 68, 69
  subsect. Diversicolores 57, 58, 64
  subsect. Heliochrominae 80
  subsect. Pluviales 71, 72
  annulata
    ssp. parasitica 80
  annulatobadia 68, 69
  atropurpurea 93
  badia 69
  caerulea 92
  carmesina 80
  carpini 92
  chloroides 92
  ciliata 69
  congoana 80
  cyanoxantha 92
  densifolia 92
  diversicolor 57-59, 64, 67-69
  emetica 93
  fellea 92, 94
  fimbriata 68, 69
  grisea 92
  heliochroma 80
  heterophylla 92
  incrassata 68, 70
  leguminosarum 71-73, 76, 78-80
  madegassensis 80
  mimetica 80
  nigricans 92
  ochroleuca 92
  olivaceoviolascens 93
  pausiaca 69
  pluvialis 71-73, 75, 79, 80
  velenovskyi 92
  venezueliana 57, 58, 60, 62-64, 67, 68
  verna 57, 58, 61, 64-68
  vesca 64
  virescens 92
  viscida 92
  xerampelina 92, 94

Saccobolus 100
Sarcogyne
  privigna 32
  regularis 32
Sarcoscypha 100, 180
  austriaca 167
  stenostoma 180
Sarcosoma 100
Sarcosphaera 100
Scabropezia 181
Schizophyllum
  commune 266
Schizopora
  flavipora 307
  paradoxa 307, 309
Schizothyrium 100
Schizoxylon 100
Scleroderris 100
Sclerotinia 100
  antarctica 467
Sclerotium
  antarcticum 467
Scodellina
  auricula 244
Scoliciosporum
  chlorococcum 32
Scopulariopsis 291, 295, 298, 300
Scutellinia 149-158, 161-163, 165-176, 178, 182-185
  sect. Reticulatae 181
  abundans 150
  adusta 150
  affinis 150
  ahmadii 164
  albobadia 151
  alboflava 151
  albospadicea 151
  alnea 151
  alpina 152
  ampullacea 167
  anemone 152
  arctespora 153
  arenicola 153
  arenosa 153, 154
  articulata 154
  ascoboloides 154
  asperior 154
  aurantia 155
  aurantiopsis 156
  badioberbis 175
  balansae 179
  barlae 155
    f. aurantiaca 155
  blumenaviensis 156
  brasiliensis 156
  brunnea 156
  carneorufa 157
  carneosanguinea 157
  cervorum 150, 167, 177
  chaetoloma 158
  coccinea 158
  coelopus 158
  coerulea 158
  coprinaria 159
  coprinella 159
  coprogena 159
  cretea 159
  crinita 150, 167, 177
  crispata 159
  dalmeniensis 160
  ditricha 161
  diversicolor 161
  erecta 162
  fimbriata 162
  fissilis 162
  flava 162
  flavobrunnea 162
  fulvescens 163
  fuscoatra 163
  fusicarpa 163
  geaster 163
  gelatinosa 164
  gilva 164
  gregaria 164
  hainesii 164
  hazslinszkia 165
  hemisphaerica 165
  heterospora 165
  hinnulea 165
  hirta 165
  hirtipes 166
  hirtococcinea 166
  hrabanovi 154
  hybrida 166
  hyperborea 156
  hystrix 167
  imperialis 167
  insignis 167
  insignispora 182
  irregularis 167, 168
  ischnotricha 168
  japonica 168
  jungneri 179
  kerguelensis 154, 467, 480
  laeticolor 168
  lanuginosa 169
  lapidaria 169
  lasioboloides 170
  laxmannii 170
  lentiformis 170

livida 171
lugubris 171
macrochaeta 172
macrospora 172
maculosa 172
marginata 183
martii 172
melaloma 173
melastoma 173
michiganensis 173
miniata 173
minor 156
minutella 183
nigra 173
ochroleuca 174
oligotricha 174
olivascens 167
pallida 174
palustris 174
patagonica 154, 156
pellita 174
phaeoloma 175
phlyctispora 175
phymatodea 175
pilosa 176
plumieri 176
polytrichi 176
praecox 177
pratensis 177
pseudotrechispora 178
pulcherrima 177
regalis 177
rhizomorphae 177
rubicunda 178
rubra 178
schistarenaria 179
scubalonta 179
scutellata 162, 166, 176-178
  f. bulbopilosa 157
  f. latispora 170
semiobscura 179
sepulta 180
sequoia 180
stenostoma 180
stercorea 180
sublivida 181
subreticulata 181
sumneriana 181
superba 181, 182
tenuis 182
theleboloides 182
trechisperma 182
trechispora 182
  f. brachyacantha 156
uliginosa 182
umbrata 153, 182, 183
  f. antarctica 152, 183
umbrorum 157, 165, 177, 184
vinosobrunnea 183
vitellina 184
wimpfeniana 184
woolhopeia 185
Scutellospora
  calospora 252
  coralloidea 252
  gilmorei 252
  pellucida 252
  savannicola 251
Scutula 100
Scutularia 100
Scytinostroma
  galactinum 272
Sepultaria 100, 155, 164, 169, 239
  arenicola 164, 169, 174
  aurantia 155
  geaster 163
  lanuginosa 169
Serpula
  himantioides 267
Sistotrema
  brinkmannii 270
  coroniferum 270
  diademiferum 270
  muscicola 270
  raduloides 270
Skeletocutis 308
  amorpha 275, 308
  nivea 275
  stellae 275
  subincarnata 275
  subsphaerospora 307
Skvortzovia
  furfurella 375, 384, 385
Solenia
  endophila 271
  polyporoidea 271
Sowerbyella
  imperialis 167
  radiculata 173
Sparassis
  crispa 276
Spathularia 100
Sphacelotheca
  foveolati 365, 367
  panici-teneriffae 365, 367, 370
  tricholaenae 367
Sphaeridiobolus 100
Sphaerobasidium
  minutum 270
Sphaeronaema 339

  - indicum 339
  - multirostratum 339, 340, 342
    - var. macrospora 340
  - roseum 340
- Sphaeronema
  - indica 339
  - multirostrata 339, 340
- Sphaerospora
  - staritzii 180
  - strasseri 181
  - trechispora 181
- Sphaerosporella 179
  - brunnea 156, 179
  - hinnulea 158, 165, 179
- Spilopodia 100
- Spongipellis
  - spumeus 276
- Sporisorium 370, 371
  - **aegypticum** 365, **371**
  - andropogonis 367
  - **foveolati** 365, **367**
  - puellare 367
  - **tricholaenae** 365, **367**
- Stamnaria 100
- Steccherinum
  - ciliolatum 276
  - fimbriatum 276
  - oreophilum 276
- Stegia 100
- Stemphylium 281
- Stereolachnea 161
  - echinus 161
- Stereum
  - hirsutum 276
  - ochraceo-flavum 276
  - ostrea 276
  - rugisporum 277
- Stictis 100
- Strobilurus 42
- Stromatinia 100
- Stromatoscypha
  - fimbriata 271
- Subulicystidium
  - longisporum 270

- Tapesia 100
- Taphrina 100
- Tarzetta 152
- Teloschistes
  - chrysophthalmus 32
- Teratosperma 484
  - litchii 484
- Thecaphora 281, 365, 370
  - ammophilae 281
  - andropogonis 281
  - berkeleyana 281
  - herteriana 281, 282
  - hyalina 370
  - seminis-convolvuli 370
  - **solani** 365, **370**
  - westendorpii 281
- Thecotheus 100
- Thelebolus 100
- Thelephora
  - terrestris 277
- Thelidium
  - pyrenophorum 32
- Thelocarpon
  - laureri 32
- Thyronectria
  - hyperantarctica 467, 474
- Tilletia 367
  - controversa 365, 367
  - elymicola 365, 367
  - hordeina 365, 367
  - lolii 367
  - trabutii 365, 367
- Tolyposporium 281
  - aterrimum 281
- Tomentella
  - brevispina 277
  - calcicola 277
  - coerulea 277
  - ferruginea 277
  - fuliginea 277
  - lateritia 277
  - molybdaea 277
  - pilosa 277
  - ramossissima 277
  - subtestacea 277
- Tomentellastrum
  - brunneofirmum 277
  - floridanum 277
- Tomentellina
  - fibrosa 277
- Tomentellopsis
  - bresadoliana 277
- Trametes 313
  - avellanea 304
  - badia
    - var. sericea 322
  - **bresadolae** 303, **313**
  - cerina 305
  - cervina 276
  - cingulata 313
  - citrina 307
  - decipiens 308
  - elegans 323
  - filipponei 309
  - flavescens 309
  - floccosa 309

  gilvo-umbrina 311
  hirsuta 276, 313
  hoehnelii 313
  lignicolor 314
  membranaceus 317
  nigrescens 317
  ochracea 276
  ochroflava 326
  parvula 317
  pavonia 317
  praetervisa 318
  pruinata 318
  pubescens 276
  pulchella 318
  radiato-rugosa 303, **319**
  retirugis 319
  rubricosa 321
  salicina 322
  similis 322
  subcervina 324
  subsinuosa 324
  tephroleucus 313
  trogii 276
  tuberculata 325
  versicolor 276, 315
  zimmermanni 326
Tranzschelia
  fusca 387
Tranzscheliella
  kazakhstanica 372
  otophora 372
Trapelia
  coarctata 32
  involuta 32
Trapeliopsis
  flexuosa 32
Trechispora
  cohaerens 270
  farinacea 270
  mollusca 270
Trichaptum
  abietinum 276
  biforme 276, 309
  byssogenus 321
  laricinum 276
  subchartaceum 276
Tricharia 100, 154, 167, 171, 173, 179, 183, 185
Tricharina 154, 155, 167, 170, 171, 173, 179, 183, 185
  bisetosa 151
  gilva 162, 164, 169, 170, 183
  ochroleuca 174
  praecox 177
    var. cretea 159
Trichoglossum 100
Tricholoma 1, 10, 16, 18-20, 48
  auratum 1, 10, 13, 14, 16, 18-20
  fallax 43
  flavobrunneum 1, 2, 4, 6, 8, 16, 18-20
  sulfureum 18-20
  vaccinum 18-20
Tricholomopsis
  platyphylla 266
  rutilans 267
Trichopeziza 100
Trichophaea 100, 150, 158, 162, 163, 165, 168, 171, 174, 179
  abundans 150
  affinis 150
  albospadicea 151, 185
  gregaria 158, 167
  hybrida 149, 158, 164, **166**
  sublivida 181
  woolhopeia 151, 168, 185
Trichophaeopsis 151, 168
  bicuspis 171
Trichophyton 288
Trichoscypha 100
Trochila 100
Tryblidaria 100
Tubulicium
  capitatum 378
Tubulicrinis
  calothrix 270
  effugiens 270
  glebulosa 271
  medius 271
  subulatus 271
Tuburcinia 281, 282
  ceratocephali 370
  champagnei 370
  melicae 282
  mussati 281, 282
Tulasnella
  violea 277
Tympanis 100
Tyromyces
  cerifluus 321
  chioneus 315
  kmetii 314
  leucomallus 315
  marianii 303, **315**, 316
  squamulosus 303, 320, **323**
  subgiganteus 322

Umbilicaria 26
Urceolella 100
Urnula 100, 150, 171
  craterium 150, 171

SEE ERRATA

Urocystis 281, 282
  allii 372
  bornmuelleri 282
  cepulae 372
  ceratocephali 365, 369, **370**, 373
  herteriana 281, **282**
  magica 372
  melicae 281, 282
Uromyces
  hedysari-obscuri 388
  triquetrus 388
Ustilago 371, 372
  aegyptica 365, 371
  allii 371
  apscheronica 365, 371
  aschersoniana 365, 371
  ceparum 371, 372
  gausseni 372
  halophila 365, 372
  schismi 365, 371
  stipae-barbatae 365, 372
  tricholaenae 365, 367, 370
  violacea 372
  violaceo-verrucosa 365, 372, 373
  welwitschiae 365, 372, 373
  williamsii 372

Vararia
  granulosa 272
  investiens 272
  racemosa 272
  sphaericospora 375, 384-386
Velutaria 100
Verpa 100
Verrucaria
  fuscella 32
  muralis 32
  nigrescens 32
  viridula 32
Vesiculomyces
  citrinum 271
Vibrissea 100

Wilcoxina, 180
  alaskana 180
  sequoia 149, **180**
Wolfina
  aurantiopsis 156
Wrightoporia
  avellanea 276, 304
Wynnella 100
  auricula 244
  silvicola 244, 245

Xanthomaculina 448, 453
Xanthoparmelia 279, 353, 355, 357, 401, 402, 448, 453
  acrita 404
  alexandrensis 357
  amableana **401**
  amplexula 358
  angustiphylla **401** , 405
  argentinensis 405
  barbatica 354
  bibax **401**
  bicontinens 405
  boonahensis 353, **354**, 356
  camtschadalis 403
  ceresina 401, **402**
  clivorum 401, **402**
  colensoica 353, **355**, 356
  coloradoensis 401, **402**
  consociata 361
  conspersa 401
  convexula 279, 401, **402**
  cordilleriana 406
  coreana 401, **402**
  cumberlandia 279
  desertorum 401, **402**
  dubitata 360
  endochromatica 403
  endochrysea 401, **403**
  endomiltoides 404
  felkaensis 401, **403**
  filsonii 357
  flindersiana 360
  geesterani 401, **403**
  gerhardii 353, **355**-357
  hedbergii 403
  heinari 353, **357**, 359
  hypopsila 401
  incrustata 358
  inuncta 401, **403**
  karamojae 402
  krogiae 401, **403**
  kurokawae 404
  lavicola 401, **404**
  leonora 401, **404**
  lineola 402
  louisii 355, 357, 363
  lynii 353, **358**, 359
  marroninipuncta 401, **404**
  metaclystoides 361
  mexicana 402
  monticola 401, **404**
  namaquensis 402
  neoconspersa 401, **404**
  neopropagulifera 279
  neorimalis 360
  norpraegnans 353, **358**-360
  oblisata **279** , 280

parvoclystoides 353, 359, **360**, 361
pertinax 402
phaeophana 402, 404
planilobata 401, **405**
praegnans 358, 360
pseudohungarica 401, **405**
punctulata 401, **405**
pustuliza 357
scabrosa 358
segregata 353, **361**, 362
shebaiensis 355
somloensis 402, 403, 405, 406
spargens 401, **406**
stenophylla 402
stenosporonica 355
streimannii 361
subdecipiens 406
subdiffluens 405
sublaevis 401, **406**
subnigra 403
subramigera 403
taractica 402
tegeta 405
tinctina 406
ulcerosa 406
unctula 401, **406**
weberi 403
wrightiana 401
xanthomelaena 357
xanthomelanoides 353, 362, **363**
xizangensis 401, **406**
Xanthoria
  fallax 32
  polycarpa 32
Xeromphalina
  campanella 267
Xylogramma 100
Xylographa 100

Zukalina 100

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